This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

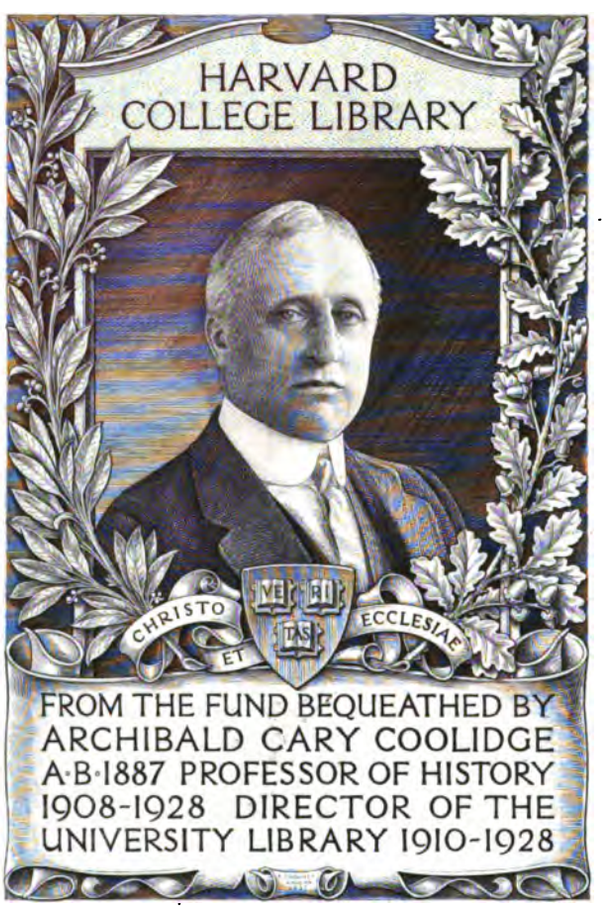
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Eng 1389.07.5F



Digitized by Google

Digitized by Google

Digitized by Google

ROYAL COMMISSION ON MINES.

MINUTES OF EVIDENCE

TAKEN BEFORE THE

ROYAL COMMISSION ON MINES,

WITH INDEX AND APPENDICES.

VOLUME II.

Presented to both Houses of Parliament by Command of His Majesty.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY M'CORQUODALE & CO. LIMITED, ST. THOMAS STREET, S.E.

And to be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LIMITED, 109, FETTER LANE, FLEET STREET, E.C., and
32, ABINGDON STREET, WESTMINSTER, S.W.; or
OLIVER AND BOYD, EDINBURGH; or
E. PONSONBY, 116, GRAFTON STREET, DUBLIN.

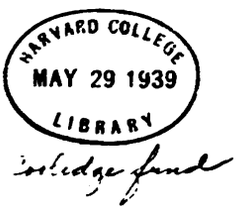
1908.

[Cd. 3873.] *Price* 6*s.* 5*d.*

EYRE & SPOTTISWOODE, WESTMINSTER.

Digitized by Google

Eng 1389.07.5F



Digitized by Google

ROYAL COMMISSION ON MINES.

CONTENTS.

PAGE.

LIST OF WITNESSES - - - - - - - - - - - - - - - - - - v

MINUTES OF EVIDENCE - - - - - - - - - - - - - - - - - 1

LIST OF APPENDICES - - - - - - - - - - - - - - - - - 294

APPENDICES - - - - - - - - - - - - - - - - - - 295

INDICES TO MINUTES OF EVIDENCE :—

I. General Index - - - - - - - - - - - - - - - - 325

II. The Evidence of each witness indexed separately - - - - - - - 340

LIST OF PLATES.

Number of Plate.	Description.	Page.
I.	Part of Courrières Collieries, Pas-de-Calais, France, showing some of the principal workings affected by the Explosion, March 10th, 1906.	17
II.	Workings in the Seven Feet Banbury Seam, Talk-o'th-Hill Colliery Explosion, May 27th, 1901.	17
III.	Suggested Scheme of Isolation by Wet Spaces - - -	20
IV.	Road with Concrete Roof and Sides, Cinderhill Pit, Babbington Coal Company.	33
V.	Roads with Plastered Sides, Cinderhill Pit, Babbington Coal Company.	33

Wt. 2013/21027. M°C. & Co. Ltd.—1000. 1/08.

Digitized by Google

LIST OF PLATES—*continued.*

Number of Plate.	Description.	Page.
VI.	System of Main Roads, Cinderhill Pit, Babbington Coal Company	38
VII.	Position of Explosion Doors, Cinderhill Pit, Babbington Coal Company.	39
VIII.	Explosion Doors, Cinderhill Pit, Babbington Coal Company -	39
IX.	Systematic Timbering at the Babbington Collieries - -	43
X.	Low Main Seam, Blackwell Colliery, showing position of Dustless Arching, which is believed to have turned the direction of the Explosion of November 11th, 1895.	62
XA.	Blackwell Colliery Explosion, effect of Dustless Arching, November 11th, 1895.	62
XI.	Water Spraying Apparatus in use at the Blackwell Collieries -	117
XII.	Altofts Colliery, Silkstone Pit Explosion, October 2nd, 1886. Plan showing Roadways, Coal Face and Working Places, System of Ventilation and Main Haulage Roads, with Falls of Roof.	169
XIII.	Altofts Colliery, Silkstone Pit Explosion. Longitudinal Section of West Chain Road, showing position of Shots Nos. 1, 2 and 3, Falls of Roof, Broken Timber, Damage to Haulage, &c.	169
XIV.	Photographs showing the effect of Watering the Roadways in the Diamond Seam, 1,500 ft. below the surface, at Messrs. Pope & Pearson's Collieries, Altofts.	172
XV.	Workings in the Diamond Seam, 3 ft. 3 in. thick, 500 yards deep, at Messrs. Pope & Pearson's Collieries, Altofts.	172
XVI.	Straight Holeing and Straight Timbering with Regular Induced Fractures, at Messrs. Pope & Pearson's Collieries, Altofts.	172
XVII.	Longitudinal Section of Coal Face Regular Line of Breaks and Pack, at Messrs. Pope & Pearson's Collieries, Altofts.	172
XVIII.	Plan and Elevation of the Altofts Experimental Gallery -	176
XIX.	Iron Pit Box in use at Messrs. Andrew Knowles & Sons' Collieries.	260
XXA.	Plan of the Rescue Station at Tankersley - - - -	276
XXI.	Suggested Design for Joint Colliery Rescue Station with Gallery.	276

ILLUSTRATIONS IN TEXT OF EVIDENCE.

	PAGE
Dust-proof Tub in use at the Talk-o'th-Hill Colliery - - - - - - - - -	19
Method of Watering with Jet of Compressed Air (Talk-o'th-Hill Colliery) - - - -	21
Dust-proof Tub in use at the Whitwood Silkstone Mine - - - - - - - - -	61

Digitized by Google

ROYAL COMMISSION ON MINES.

LIST OF WITNESSES.

Name.	Description.	Questions.	Page
ARMSTRONG, WILLIAM - -	Manager of Wingate Grange Colliery, Co. Durham.	16495–16882	200
BLACKETT, WILLIAM CUTHBERT -	Agent to the Charlaw and Sacriston Collieries Co., Ltd., Durham. (*Durham Coalowners' Association.*)	14459A–14894	132
BRAGGE, GEORGE STEPHENSON -	Manager of Granville Colliery, Swadlincote, Burton-on-Trent. (*National Association of Colliery Managers.*)	12653A–12919	81
BRAIN, FRANK - - - -	Managing Director of Trafalgar Colliery, Forest of Dean. (*Forest of Dean Coal-owners' Association.*)	16368A–16494	196
BRAMALL, HENRY - - -	Managing Director of Messrs. Andrew Knowles & Sons, Ltd., Manchester.	18580A–18914	260
CARNES, CHARLES SPEARMAN -	Mining Agent for Messrs. Bolckow, Vaughan & Co., Ltd., Durham.	16883–17294	209
CHAMBERS, WILLIAM HENRY -	Managing Director of the Denaby and Cadeby Main Collieries, Ltd. (*South Yorkshire Coalowners' Association.*)	15171–15448	153
FORGIE, JAMES TENNANT - -	Director of Messrs. William Baird & Co., Ltd. (*Scottish Coalowners.*)	17548–17979	227
FOWLER, GEORGE - - -	Agent to the Babbington Coal Co., Ltd., Nottingham.	10997–11331	30
GALLOWAY, PROF. WILLIAM -	Mining Engineer, Late Professor of Mining of the University College of South Wales and Monmouthshire.	10168–10544	1
GARFORTH, WILLIAM EDWARD -	Chairman of Messrs. Pope & Pearson, Ltd., Altofts Collieries, Normanton. President of the Mining Association of Great Britain. (*West Yorkshire Coalowners' Association.*)	15617A–15937	169
HABERSHON, MATTHEW HENRY -	Mining Engineer to Messrs. Newton, Chambers & Co.'s Collieries, Thorncliffe, near Sheffield	18914A–19095	270

Digitized by Google

LIST OF WITNESSES—*continued.*

Name.	Description.	Questions.	Page.
HANNAH, DAVID	Agent to Messrs. D. Davis & Sons, Ltd., Ferndale. (*Monmouthshire and South Wales Coalowners' Association.*)	19095A–19620	278
HENSHAW, ALBERT MAYON	Director and General Manager of the Talk-o'th'-Hill Colliery, Stoke-on-Trent. (*North Staffordshire Colliery Owners' Association.*)	10545–10996	14
HODGES, ISAAC	General Manager and Engineer for Messrs. Henry Briggs, Son & Co., Ltd., Whitwood Collieries, Normanton. (*National Association of Colliery Managers.*)	11837A–12136	59
HOLLINGWORTH, GEORGE HENRY	Mining Engineer. (*National Association of Colliery Managers.*)	11331A–11837	45
HOOD, WILLIAM WALKER	Managing Director, Glamorgan Coal Co., Ltd. (Llwynypia), &c.	13288A–13662	100
MOWATT, DAVID MARR	General Manager of the Collieries of the Summerlee Iron Co., Ltd. (*Scottish Coalowners.*)	17979A–18255	242
NEVIN, JOHN, J.P.	Mining Engineer and Colliery Owner. (*West Yorkshire Coalowners' Association.*)	14182A–14459	124
PARRINGTON, MATTHEW WILLIAM	Agent at the Collieries of the Wearmouth Coal Co., Ltd. (*Durham Coalowners' Association.*)	15448A–15617	163
PEACE, GEORGE HENRY	Managing Director of the Astley and Tyldesley Collieries, Ltd. (*Lancashire and Cheshire Coalowners' Association.*)	16112A–16368	188
PILKINGTON, CHARLES	Director of the Clifton and Kersley Coal Co., Ltd., Clifton, near Manchester. (*Lancashire and Cheshire Coalowners' Association.*)	14894A–15170	145
RHODES, CHARLES EDWARD	Mining and Consulting Engineer. (*South Yorkshire Coalowners' Association.*)	18255A–18580	249
RICHARDS, TALIESIN EDWARD	Agent and General Manager to Messrs. Lockett's Merthyr Collieries, Ltd. (*National Association of Colliery Managers.*)	12136A–12653	69
ROUTLEDGE, WILLIAM HENRY	Mining Agent for Messrs. Partridge, Jones & Co., Ltd., Colliery Proprietors, Monmouthshire. (*South Wales and Monmouthshire Coalowners' Association.*)	12919A–13288	89
STEVENSON, HENRY	Agent and Manager of Linby Colliery, Nottingham. (*Leen Valley Coalowners' Association.*)	15937A–16112	181
TATE, SIMON	Mining Agent for Messrs. Walter Scott, Ltd., Trimdon Grange, East Hetton, and Scotswood Collieries, &c. (*North of England United Coal Trade Association.*)	17294A–17547	219
TODD, JOHN T.	General Manager of the Blackwell Colliery Co., Ltd. (*Midland Counties Colliery Owners' Association.*)	13662A–14182	110

Digitized by Google

MINUTES OF EVIDENCE

TAKEN BEFORE THE

ROYAL COMMISSION ON MINES.

SIXTEENTH DAY.

Wednesday, 23rd January, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
WM. ABRAHAM, Esq., M.P. (Rhondda).
F. L. DAVIS, Esq.
ENOCH EDWARDS, Esq., M.P.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.

S. W. HARRIS, Esq. (*Secretary*).

Prof. WILLIAM GALLOWAY called and examined.

10168. (*Chairman.*) You are, or have been lately, Professor of Mining of the University College of South Wales and Monmouthshire ?—Yes.

10169. Are you so still ?—No, I ceased to deliver lectures about six years ago.

10170. For some considerable time before that you were one of the Inspectors of Mines ?—Yes.

10171. I believe you have experimented largely with regard to coal-dust explosions ?—I have.

10172. You gave evidence before the Royal Commission on Coal-Dust Explosions ?—Yes, and before the previous Royal Commission on Accidents in Mines. I may add that I made all the shot-firing experiments for the Commission on Accidents in Mines.

10173. I propose, if that course will meet the views of the Commissioners, to put in your Statement, copies of which we have all received, as a heading to the evidence to be taken to-day, so that we can refer to your evidence by reference to the number of each paragraph without going through each paragraph verbatim and ask you questions upon it. In that way we shall be able more shortly to deal with your evidence than if it had not been furnished to the members of the Commission previous to the examination ?—Yes.

The Witness handed in his Statement as follows :—

(1) Permanently dry and dusty mines are 700 ft. and upwards in depth.

(2) Except in the case of very brittle coal, there is generally insufficient dust at the working faces to initiate or carry on an explosion.

(3) Dangerous accumulations of coal dust are almost exclusively confined to the main haulage roads.

(4) The sources of this dust are as follows :—

(*a*) Coal which escapes through seams or openings between the bars or boards of which the bodies of the mine wagons are constructed, or is shaken from that part of the load which is piled up higher than their sides, or is left behind when they are accidentally overturned and the larger pieces only taken away. This coal is ground by degrees into the form of dust by the traffic. Its finest particles are sifted out from the rest by eddies and currents of air in which they float for some distance and then settle on the surface of the coarser remainder, on projecting ledges at the sides of the roads, and on horizontal and other timber.

(*b*) Dust blown off the coal contained in the wagons during their transit from the working places to the winding shafts.

(*c*) Dust from the screens that is carried down the downcast in the descending air current.

(5) The first is by far the most prolific source.

(6) This strewing of the roads with dust and coal does not take place on railways at the surface, over which millions of tons are carried every year at a much higher velocity than the maximum attained by wagons in a mine, simply because railway wagons are dust-tight, and have axle and buffer springs, and the load is not piled up above the level of the upper edges of their bodies.

(7) The conclusion seems to be obvious that if mine wagons were similarly constructed and similarly fitted, the result, as regards strewing the roads with pieces of coal and dust, would be similar. If they had springs, the continuous state of tremor which grinds and breaks the coal and produces dust during transit would be to a

Digitized by Google

Prof. W. Galloway.

23 Jan. 1907.

large extent, if not altogether, avoided, and very little dust would be blown off them when running outwards towards the shaft.

(8) Ever since the occurrence of the Altofts explosion in 1887 it has been my opinion that this is the best solution of the coal-dust difficulty, and the only really efficient one; that is to say, the accumulation of dust should be prevented.

(9) I referred to this at page 15 of my Report to the Home Secretary on the Universal Colliery explosion.*

(10) The explosion at Altofts Colliery failed to reach the working faces at any point; it was confined to the main intakes, which were, or had been, haulage roads; and it did not penetrate into the return airways which contained all the firedamp produced in the mine, but no coal dust. I stated these facts in a paper to the Royal Society, which was published in the Proceedings in 1887.

(11) In that case the mine wagons, although not dust-tight, had only narrow seams between the boards of which their bodies were constructed; and they were filled only to the level of the upper edges of their sides, so that very little dust escaped through the seams and no coal fell off the top.

(12) In the operations of blasting the roof to make height in the roadways near the faces, and removing the resulting debris, all traces of coal were removed along with the debris, and the floor assumed a light grey colour.

(13) As the faces kept continually advancing this condition of the floor of the roadways near them remained always the same.

(14) Now as the number of wagons of coal that had passed over any given point in any roadway in the mine was directly proportional to the distance of that point from the face, and as the quantity of dust that escaped from each wagon may be assumed to have been continuous and uniform, the quantity of dust lying upon the floor at any given point was also directly proportional to the distance of that point from the face.

(15) Therefore in passing along any road from the face outwards, the following phenomena were observable: For a distance of perhaps 20 yards there was no appreciable coal dust; then a faint trace began to be seen between the rails, and for a few inches on each side of them; the quantity increased appreciably, but very slowly, for, say, the next hundred yards, but was still confined to the space between the rails and near them on each side; when the cross headings were reached, along which the wagons from a number of faces were reached, there was a further and very marked increase, and the dust was spread further outside the rails; and when the main haulage roads along which the whole of the wagons from a district of workings were reached, there was coal-dust everywhere all the way out to the shaft.

(16) The explosion was most violent in the main haulage roads; but lost its intensity on nearing the faces; and died out altogether at a distance of perhaps 100 yards from faces 40 yards wide, and less from wider faces in proportion to their greater width.

(17) At intervals during the last three months, I have been observing a cross measure drift with a gradient of 1 to 5½ upwards towards the shaft over which 20 to 25 trains of eight or 10 wagons, each wagon containing about one ton of coal are drawn daily at the rate of four or five miles an hour from a small district of workings, by means of a wire rope.

(18) The wagons have sheet-iron bodies; they are dust-tight except that some of them have rather loosely fitting sheet-iron doors at one end; and the coal is built up above the level of their upper edges to a height of from 9 to 12 inches.

(19) Within the last few days I have seen that this drift which contained no coal dust to begin with, does not yet contain an appreciable quantity; although I have no doubt that in course of time dust will accumulate in it more and more.

(20) If the accumulation of dust in the main haulage ways cannot be prevented, or if it is decided to give the owners of collieries an alternative choice, one of which is to render the dust, if allowed to collect in the main haulage ways, innocuous in one way or another, then two cases have to be considered:—

(1) That in which watering the dust either along the whole length of the roadway, or in sections, can be done without destroying the roadway or rendering the cost of repairs unbearable.

(2) That in which water cannot be employed owing to the tendency of some of the strata to swell like a sponge when they absorb water and to close the roadway with irresistible pressure.

(21) The first case is comparatively simple: Either fine sprays can be produced at stand-pipes placed on a hydraulic main at stated distances apart, and in this case the water must pass through a very perfect filter before it enters the hydraulic main; or a hose 40 or 50 feet long coupled to a stand-pipe at one end provided with a rose at the other, and manipulated by a specially appointed workman, can be employed for watering a part of the road of twice its own length and then be removed to another stand-pipe, and so on, for the whole length of the road.

(22) When watering was first introduced into the dry collieries in the South Wales Coalfield, the first of these methods became almost universal, and continued for a time; but the want of care to provide a filter and have the pipes absolutely clean before commencing gave rise to much trouble from the stopping up of the spray-producing nozzles, and it was gradually superseded by the second method, in which the holes in the rose being larger there is not the same amount of trouble in keeping them clean.

(23) The second method is the one that appears to have found most favour in Germany where its cost, in the case of extensive mines, is sometimes very great. Mr. G. A. Meyer, of pneumatophor fame, informed me that the watering appliances used in the mines belonging to the Hibernia Company of which he is one of the principal engineers, had cost the sum of £20,000.

(24) Mr. Stokes' observation, 9537–40, of a heap of dry dust in a mine in South Wales with simply a film of wet dust over it, and other remarks to the effect that dry dust was seen floating on the surface of water, are not to be taken too seriously. They only point to the fact that the operation of watering in the cases referred to had been intermitted or neglected for so long a time that the dust had become perfectly dry, and that it had been resumed immediately before the visit referred to was made.

(25) When watering is carried on continuously at regular intervals of time, longer or shorter, according to the hydrometric condition of the air, but sufficiently frequent to prevent the dust from ever becoming quite dry, the existence of a heap of dust such as Mr. Stokes described is impossible. In a well-watered roadway there is no dry dust anywhere. Many years ago I took some French Commissioners along 400 yards of a roadway in Llwynpia Colliery in which only a watering tram was used for wetting the floor. Before descending the mine they were positive that dust would be found on the cross timbers; but they found to their astonishment and discomfiture when they searched most carefully that there was none anywhere.

(26) Again, I found that the Pochin explosion had been stopped at the entrance to a district in which the floor of the principal haulage road was slightly damp, more especially between the rails. This condition was due to the fact that water was occasionally brought out in a cask from the deepest point of the district, and that the cask not being absolutely water-tight some of its contents had dropped on the ground over which it was passing.

(27) In neither of the two cases just mentioned was there a single drop of water directed upon either the roof or sides of the roadway. The floor alone was damp—and in all other cases in which I have seen an explosion arrested on coming to a naturally damp part of the floor, the sides and roof were, as a rule, quite dry, and never had been wetted or washed down artificially.

(28) After the occurrence of the great explosion at Abercarn some years ago, Mr. Cadman, the Chief Inspector of Mines for the South Western District, wrote to inform me that the explosion had been arrested and prevented from entering one district of workings at the entrance to which the floor was naturally damp for a distance of some 200 yards, if I remember rightly, and that 70 men had come out alive from that district.

*Cd. 947, 1902.

Digitized by Google

(29) The Altofts explosion failed to enter one of the main haulage roads, the floor of which was damp for a short distance at the point where the stables were situate, having been rendered so by the accidental spilling of water from the pails being carried to water the horses, but dry throughout the whole distance from that point to the face. Two men who were at work in that roadway came out alive. I mention this fact in my paper to the Royal Society referred to above.

(30) I mention these facts to show that a damp floor alone, without any wetting of the roof and sides appears to be sufficient to stop an explosion; at least there can be no question but that it did so in the cases named above; and with all deference to the opinions of those witnesses who have advocated a complete deluging of roof, sides and floor, "swilling," I think, was one of the expressions used, I am of opinion from what I have myself observed that a gentle damping of the floor at comparatively short intervals of time is quite sufficient for the purpose in view.

(31) When this is done there is no dust present to be raised by the ventilating current and by eddies produced by passing trains, and every particle of that which floats in the air or settles temporarily on the timber becomes fixed and *hors de combat* the instant it touches the floor.

(32) At a point in a mine which has been dry up to the time a shot is going to be fired, watering the floor alone would be insufficient if there were dry dust resting on the timbers near the site of the shot, and that dust ought certainly to be dislodged and damped.

(33) As has been experienced in the case of Abercarn, Altofts and other great explosions, a damp zone of sufficient width will arrest an explosion. To the best of my recollection, the width of the zone at Altofts was considerably less than 100 yards, but Mr. Garforth can perhaps speak as to this; and the width of the one at Abercarn is probably mentioned in Mr. Cadman's report.*

(34) In any case there can be no question as to the efficiency of a zone provided it is wide enough, and I should consider 200 yards to be ample in any case.

(35) Doors, such as those mentioned by Mr. Stokes (9541), intended to be shut automatically, were set up by Mr. Buddle early in the last century, and their construction and mode of action were explained by him probably to the Royal Commission which sat in 1835. But as an explosion travels with great velocity, in some parts of its course at any rate, judging by its effects, the flame would probably have passed the doors long before they could close, if, like Mr. Buddle's doors, they shut under the action of gravity after their support had been driven out by the blast.

(36) For mines or particular seams of coal in which watering cannot be adopted without irreparable injury to the roadways, the alternatives are:

(i) To prevent the accumulation of the dust.

(ii) To build an arch and invert of a certain length at some point in each haulage road, and keep it constantly damp.

(iii) To destroy the combustible properties of the coal dust by mixing some damping or cooling substance with it in sufficient quantity to render it non-inflammable when mixed with air.

(37) The first and second alternatives have been already described.

(38) In 1878 I specially visited a mine in North Staffordshire, in which the dust on the floor of the roadway was cemented into a tough cake by common salt derived from the evaporation of brine which had dropped from the roof, and found that at points where the dropping had ceased the floor remained damp on account of the hygroscopic nature of the salt. But the mine was not deep enough to have a very dry atmosphere, and after carefully considering the question, and probably after having made experiments, I came to the conclusion that common salt would not keep the dust damp in a very dry mine.

(39) About the same time, or previously, the late Sir George Gabriel Stokes, then Secretary, afterwards President of the Royal Society, suggested to me the use of calcium chloride (one of the most hygroscopic salts obtainable) for this purpose. Accordingly, I obtained a quantity of that salt, made a solution of it in water, and sprinkled the solution copiously on a certain area of dry dust at a point in one of Nixon's Navigation Collieries, where it could remain undisturbed for any length of time I desired. After the lapse of a few days I returned to examine this area, and found that the dust was mixed with small crystals of the salt, but had become quite dry. The air was too dry to admit of the calcium chloride retaining any moisture in addition to its water of crystallisation.

(40) It seems, therefore, in vain to look for a salt that would, if sprinkled on the dust, retain more water than that of its crystallisation, much less produce visible dampness by attracting moisture from the air in dry mines.

(41) On the other hand, coal dust mixed with certain proportions of salts containing large quantities of water of crystallisation, or with much larger proportions of the dusts of clay, shale, limestone, chalk or other substances, would not be inflammable or capable of propagating an explosion, and therefore *if the coal dust in a roadway in a mine were regularly strewn, say daily, with a sufficient quantity of one of these salts or dusts, it would be thereby rendered quite as innocuous as if it were damped with water.* Just how much salt or inert dust would require to be used would depend, of course, on the rate at which coal dust accumulated in a given mine, and the proportion required to render the coal dust innocuous would have to be determined by experiment. For instance, six or seven years ago I found the proportions of chalk dust necessary to destroy the inflammability of lycopodium, but I did not experiment with coal dust, as the subject seemed, at that time, to be a very long way off from the region of those likely to be considered.

(42) To sum up, the various alternatives appear to be as follows:—

(1) To prevent the accumulation of coal dust.

(2) To water it either throughout the whole length of the haulage ways or in zones.

(3) To mix it with a salt or with an inert dust.

(43) In shot-firing, it is necessary to water the floor in every case, and the roof and sides also where required. It ought to be made compulsory to water with a spray or rose, with water at not less than a certain pressure in this case. In fact, an apparatus of some definite construction might be specified, because the methods now followed are as a rule crude and inefficient.

(44) I have said nothing about introducing steam into the air-current, either alone or in conjunction with compressed air, since the heat is objectionable, and the process might become very expensive. For instance a mine with 200,000 cubic feet of air per minute would in cold weather require about three tons of steam per hour to keep the air moist. Exhaust steam from a ventilating fan was turned into the downcast at Pochin Colliery, and kept the roads pleasantly damp for some hundreds of yards, and I have in several instances used steam along with compressed air in underground engines partly to prevent the formation of ice, partly to obtain a better result from the compressed air, and have then observed that the intake airway was damp for a distance of something like 200 yards.

10174. You begin by saying that the mines which are permanently dry and dusty are 700 ft. and upwards in depth?—Yes.

10175. And that shallower mines are not, in your opinion, permanently dusty?—No, as a matter of fact they are not. Mines about 700 ft. deep are dry in winter and cold weather, and damp in moist warm weather.

10176. Would you say that that applied all over the United Kingdom?—It applies everywhere, all over the world.

10177-8. That you are satisfied of?—Yes. It depends upon the average annual temperature of the place at which the mine is. It is a point which I mentioned in my first paper on "Coal Dust" to the Royal Society.

10179. Then you say, that except in the case of very brittle coal, there is generally insufficient dust at the working faces to initiate or carry on an explosion. I suppose that that would apply to the very large majority of coal mines?—Yes.

10180. There are few coal mines in which, in your opinion, the coal is so brittle as to constitute any considerable danger of dust at the working faces initiating or carrying on explosions?—There are few that I have seen, but I have heard of cases of very brittle coal in Belgium in

* Since giving my evidence I have read Mr. Cadman's Report on the Explosion (1879), and on page 3 he makes the following reference to the fact: "The district marked No. 2 was comparatively uninjured by the explosion, and all the men working there escaped, but no one came out alive from any other." That is all.—W.G.

Digitized by Google

Prof. W. Galloway.

23 Jan. 1907.

which there is a great deal of dust, and also a few in this country.

10181. Do you express the opinion, which I believe is entertained by a great many other people, that the dangerous accumulations of coal dust are almost exclusively confined to the main haulage roads?—Yes.

10182. Then you go on to say what are the sources of this dust?—Yes.

10183. In paragraph 5 of your statement you say that in your opinion the construction of the wagons is responsible for most of the coal dust that is distributed over the haulage roads?—Yes, the construction and method of filling, or rather, of over-filling, I might say.

10184. You compare the state of the dust in haulage roads of mines with the state of the dust on railways, where coal is carried at a much higher speed, and yet there is very little dust strewn on the lines?—Practically none.

10185. Then you dwell upon the desirability of having these wagons properly made, so that the dust would not shake out, and you suggest that they should not be over full, and that they should have proper springs?—My experience is that wagons with springs are better than others in regard to that point.

10186. You sum up the result of your experience by saying that since the Altofts explosion in 1887 it has been your opinion that the best solution of the coal dust difficulty, and the only efficient one, is that the accumulation of dust should be prevented?—Yes.

10187. And you refer to your Report to the Home Secretary, mentioning that opinion?—Yes.

10188. Then you go on to give certain facts with regard to the Altofts explosion which, in your opinion, corroborate your view?—Yes. That was really the first thing which called my attention to the question.

10189. That is to say, the great necessity that there is of as far as possible freeing the haulage roads from coal dust?—Yes.

10190. That explosion brought that view before your mind very strongly in a way in which it had never been brought before?—Yes, it brought to my mind the fact that it could be done. Before that I had rather thought that it would be very difficult.

10191. Then there is another thing which struck you very much in reference to this explosion, that the further you go from the working face along the haulage road, the more the dust accumulates?—Yes—on account of the small quantity of dust escaping from each wagon as it went along.

10192. Then you mention some observations you have made with some dust-tight wagons?—Yes, they were being drawn up at the rate of about 200 a day, and I have been observing for the last three months that there is hardly any dust in the roadway now.

10193. And you consider that if the wagons had been imperfectly constructed, if they were of the type that is constantly used now, as I understand, in coal mines, there would have been a very great deal of dust?—Yes, undoubtedly—if they had been drawn more quickly.

10194. Then you begin to deal at Paragraph 20 with the subject of watering, and you say that there are two ways of dealing with the danger of explosions: first, by watering the dust either along the whole length of the roadway or in sections where it can be done without destroying the roadway or rendering the cost of repairs unbearable; and, secondly, in cases in which water cannot be employed owing to the tendency of some of the strata to swell like a sponge when they absorb water and to close the roadway with irresistable pressure, you must, as I understand, adopt some other system?—Yes.

10195. With regard to cases in which you can water the dust without doing any very considerable damage, you say you can either use fine sprays or a hose?—Yes.

10196. You consider that there is a difficulty in the way of using fine sprays owing to the tendency of the rose of the spray to choke up?—Yes; these very fine sprays are usually produced from one single opening about the size of a needle point, and the opening being so very small the slightest grain of dust closes it; for that reason the water ought to be very carefully filtered before it is admitted into the pipes.

10197. If it is filtered, and if the pipes are properly looked after, do you think that method of spraying is a good one?—Yes. I have seen it working very well indeed. But, of course, it is not essential that the water should be disseminated in that way.

10198. You say from your experience that in Germany the second method, that is to say, the use of a hose, has been employed?—Yes.

10199. What have you to say about the relative advantages of sprays and hoses?—Of course the spray has the advantage that it does not require so much manipulation; it can be turned on and left for a certain time and can then be turned off again. A man could walk along the road and turn on the sprays one after the other, and then walk back again and turn them off at intervals; whereas with a hose he has to be constantly handling the hose.

10200. But at the same time you are not prepared to say that the system which is most in favour in Germany, that is to say, the hose system, might not on the whole be preferable here?—Oh, it might. Most people have taken it up here on account of the difficulty with the sprays.

10201. You think on the whole that the balance of opinion in this country is in favour of watering by hose rather than by sprays?—Yes.

10202. In Paragraph 24 of your Statement you refer to Mr. Stokes's evidence in which he spoke of the difficulty of making the water permeate; he says that very often you have a thin film of wet dust on the top, and underneath that there would be highly explosive and absolutely dry dust. You do not agree with that; you say it is fairly easy to have a system of watering which will be sufficient and practically prevent any dry dust from being underneath?—Yes—how could that dry dust come there if the watering had been regular? It would be impossible.

10203. You mean that in order that there should be a large deposit of dry dust under the wet dust, watering must have been neglected for a very long time?—Quite so.

10204. That you elaborate in Paragraph 25 of your Statement. Then with regard to the amount of watering that would be necessary to prevent or to stop an explosion, you say that in the Pochin explosion only a very slightly damp condition of roads was sufficient to stop the explosion?—Yes.

10205. And that the explosion was, in point of fact, stopped by an accidental leakage of a water-cask?—That is all—simply the dropping of water on the road. The wetness was hardly perceptible on the road.

10206. But in your opinion it has been proved beyond the possibility of doubt that that slight damp did prevent the explosion being carried on?—Yes.

10207. Then in Paragraph 28 you deal with the explosion at Abercarn?—Yes.

10208. There you say that the explosion had been arrested and prevented from entering one district of workings at the entrance to which the floor was naturally damp for a distance of some 200 yards and 70 men had come out alive from that district. There 200 yards stopped the explosion, but I understand that in your opinion 100 yards of wet road would be quite sufficient?—Yes. I am not quite sure about the distance in that case; I think it was 200 yards, but I am speaking from memory.

10209. At all events, you are of opinion that 200 yards is an unnecessary distance?—Yes, I do not think 200 yards would be necessary.

10210. Again, with regard to the small quantity of water that sometimes will have a beneficial effect in preventing explosions, you say that in the Altofts explosion, the accidental spilling of water from pails which were carried to water the horses was enough to prevent the explosion going on?—Yes.

10211. In Paragraph 30 you continue on the same lines, and you say that a gentle damping of the floor at comparatively short intervals of time is sufficient, and that you do not advocate, as some witnesses do, the complete deluging of the roof, sides and floor?—I think it is quite unnecessary.

10212. With regard to the watering of the roof and sides as well as the floor you point out that this dust is more or less liable to be dislodged by currents of air, and that any dust which is dislodged in that way will sooner or later, most of it at all events, find its way to the floor, and if the floor is wet then the dust becomes damp and it is no longer explosive?—That is so.

10213-5. I see that in Paragraph 34 you say that 200 yards of wet zone would certainly be ample, and you are inclined to think that 100 yards would be enough?—Yes.

10216. Upon the question of doors to which you refer in Paragraph 35, I should like to ask you this

Digitized by Google

question: I suppose it is an advantage to have an absolute physical barrier to an explosion, because the physical barrier stops the afterdamp, whereas the afterdamp may of course got through the wet zone and kill people on the other side?—Yes, but of course one would require to know what the physical barrier was going to be before one could express an opinion.

10217. Such physical barrier as could not be broken down by the explosion?—Yes.

10218. However, that has very little to do with the question of watering?—No.

10219. Then you say that where particular seams of coal are such that watering cannot be adopted without irreparable injury to the roadways, there are three alternatives, namely "(1) To prevent the accumulation of the dust; (2) To build an arch and invert of a certain length at some point in each haulage road and keep it constantly damp; and (3) to destroy the combustible properties of the coal dust by mixing some damp or cooling substance with it in sufficient quantity to render it non-inflammable when mixed with air"?—Yes.

10220. With regard to the question of the accumulation of dust you have already dealt with that in your suggestions that the tubs should be made fairly dust-tight and that they should not be filled too high?—Yes.

10221. Those are your principal suggestions with regard to that point, as I understand?—Yes.

10222. Do you give in your statement the expense of building the arch and invert?—No, I do not go into that.

10223. You suggest building an arch and invert of a certain length at some point in each haulage road; that is to say, you would not require such arch to be more than 100 yards in length, or whatever distance was reckoned safe to stop an explosion?—Yes.

10224. So that however bad the roof might be, where you water, you would build such an arch for 100 yards, at intervals along the haulage road?—Yes; it would require to be decided where and how frequently these zones were to be placed. I have not noticed any expression of opinion as to the placing of the zones.

10225. Supposing a haulage road was a mile long, I suppose you would probably have to have more than one zone in that?—It would depend upon whether there was shot-firing carried on in the mine or not; because, supposing it was an intake airway a mile long, reaching the faces a mile in, then if the explosion took place at the face the explosion would travel out through that road: but then if there was a wet zone within 200 yards or 100 yards of the face, if it was possible to have it there, that would arrest it and there would be no objection in having wet zones outside that face.

10226. So that it might happen that one wet zone in a very long haulage road would be quite sufficient for the purpose?—Quite sufficient, because there would be no object in having other wet zones.

10227. So that, however bad the roof might be, and however difficult it might be to damp it, it would not matter because there would be no object in damping it at all outside the arch; you would just build an arch for the 100 yards or whatever length was necessary and the whole of the rest of the haulage road might be kept quite dry?—Yes.

10228. Then you would have to continue your arch near the face?—Yes, you would have to build a second one a little way on, which would be a very expensive way of overcoming the difficulty. Then very often these arches are crushed and have to be rebuilt two or three times. Some people build them without any intention of making wet zones of them; in some of the South Wales mines they are built regularly.

10229. But would the wetting of the arches tend to make the brickwork decay?—No, not at all; it would not suffer any harm.

10230. (*Mr. F. L. Davis.*) You mean the natural squeeze would make it necessary to rebuild them?—Yes, very often.

10231. (*Chairman.*) Then your third suggestion is that the combustible coal dust might be mixed with some damping or cooling substance in sufficient quantity to render it non-inflammable when mixed with air?—Yes; cooling substance. I take the expression cooling substance from the term which is used in the same sense in connection with safety explosives.

10232. You mention experiments which have been made with common salt and with calcium chloride, a very hygroscopic salt?—Yes. The first mention of the use of salt that I make in my statement is of a salt which naturally came on to the roadway from droppings off the roof—salt water dropping from the roof naturally—brine.

10233. But why should brine come there?—Because the Coal Measures in that part of the country are very near the Permian, and the salt water comes down into the mines.

10234. So that there is naturally salt in the mines?—There is naturally salt in that part of the country.

10235. But you say you came to the conclusion, after careful experiments, that common salt would not keep the dust damp in a very dry mine?—Yes, and the same with calcium chloride.

10236. So that your experiments did not seem to give much result, so far as regards the use of salt?—No. I observed in the evidence of some of the other witnesses that they had spoken of salt as a substance that might be used to produce dampness.

10237. But after having experimented with salt to a very considerable extent you are not of that opinion yourself?—No.

10238. I do not quite understand what you propose to mix with the coal dust. You say that limestone, chalk, or other substances would be useful, as I understand?—Yes; any substance other than a combustible substance mixed with the dust would prevent the dust from exploding if that substance was raised into the air by the same blast that raised the dust.

10239. Then how would you proceed to mix the explosive coal dust with those substances?—Supposing one wished to mix it with dry clay dust, for instance, one would fill a wagon with the dry clay dust, and have some method of sprinkling it on the road, either mechanically or by blowing. The wagon would be taken to a point near the working face, and brought backwards towards the bottom of the pit, so that the air travelling inwards would carry the dust with it towards the face. You have simply got to make a cloud of clay dust in the air, say daily, so that each film of coal dust deposited during the operations on any one day would be separated from that deposited on the next following day by a film of inert dust.

10240. Have you tried that?—No, I have not. I have tried experiments with chalk dust, which I mention here; but it is a very easy thing to do.

10241. How would it affect the health of the miners, having all this dust about? I suppose it would only be for a short time?—Yes; it would be done as quickly as a wagon could be carried along the road.

10242. Do you mean once in a shift?—Once in 24 hours would be ample.

10243. And the dust would only remain in the air for a very short time?—That is all; simply like the coal dust, nothing else.

10244. So that it might be done between the shifts, or at some time when the men were not working at the face?—Yes.

10245. So that the men would not be injured at all?—It would not go to the face any more than the fine coal dust does, and would not have more effect than the fine coal dust.

10246. Except that it would be in addition to the fine coal dust—it would be making more dust?—Yes; but it is simply a point as between that and watering. If one wishes to destroy the dust, you can do it in either of two ways; you can do it by mixing a sufficient quantity of inert dust with the coal dust, or you can do it by water. Mixing the dust in the case of mines that have very bad roofs and very bad floors would, in my opinion, be very much the better way of doing it.

10247. In Paragraph 43 of your Statement you deal with shot-firing, and there you say that the floor in every case and the roof and sides also, where required, should be watered. Well, that is the rule now?—Yes. The reason I mention it is that although I say in an earlier part of my notes that it is sufficient to water the floor in ordinary cases, yet I wish to emphasize the fact that that does not apply to the case of shot-firing.

10248. That, in fact, the whole present system ought to be continued with regard to shot-firing, that is to say, the use of water within 20 yards of it?—Yes; not only continued, but continued in a better way than it is at present; it ought to be more drastic.

10249. You say that you think it ought to be made compulsory to water with a spray or rose, with water at not less than a certain pressure?—Yes, so that it may be able to rise up and water the roof and sides. In a paper which was printed in the proceedings of the South Wales

Digitized by Google

Prof. W. Galloway.

23 Jan. 1907.

Institute of Engineers (1903) I recommended for this purpose a portable tank from which water is sprayed by means of compressed air.

10250. Therefore you would probably think that the General Rule as to watering in shot-firing ought to be altered?—It ought to be made stronger.

10251. Do you think 20 yards is a sufficient distance?—The first proposal I made was 15 yards; that is to say, before the Act was passed. Then before this distance of 20 yards was agreed to one of the Commissioners came to consult me on the matter, and I said 15 yards. He said, "Would 20 yards do?" I said, "Yes, 20 yards would be all the better."

10252. Twenty yards round the shot you think is ample?—Yes, I think so; excepting in one case; that is to say, it has to be proved yet whether some shots do not create what is called a vortex ring when they are fired. If a vortex ring is created by a shot, then it might possibly carry the ignition further. That is a point which would have to be proved by experiment.

10253. Then that has not yet been scientifically ascertained?—That has not yet been scientifically ascertained; but if a vortex ring is formed occasionally—very rarely, probably—then it might be necessary either to put up some barrier to stop the possibility of its propagation, or to water further.

10254. I have some general notion of what a vortex ring is, but I do not know how far it can be propagated. How far could such a vortex ring go, supposing it was formed?—There have been a great many shots fired to produce vortex rings for the purpose of dispersing hail clouds in Austria, so as to prevent the falls of hail which destroyed the crops. Those vortex rings have been formed by firing out of a trumpet-shaped cannon.

10255. How far do they go?—They go a long way; I do not remember at the moment how far. I refer to the subject in my Report on the Universal Colliery explosion. I do not know how far they go, but I think they destroy partitions of wood at a distance of 80 yards or 100 yards—they go with such great force.

10256. Would it not be possible to find out by experiment some form of shot-firing that did not and could not produce vortex rings?—No, because it depends upon the shape that the hole takes in the ground at the moment of firing. Of course you could stop a vortex ring by putting up any obstacle in front.

10257. (*Sir Lindsay Wood.*) That would not prevent the flash of the shot: the flash of the shot is what would be the dangerous spot?—Yes; but there are several questions that require to be answered yet, as to the temperature of the mixture of gas and air in the vortex ring, and whether that would be sufficient to ignite the gas.

10258. (*Chairman.*) You say in Appendix 2 to your Report on the Universal Colliery explosion: "A vortex ring carries the incandescent gases of the shot which produces it to a greater distance than they would otherwise attain, and by its rapid whirling motion (forwards in the direction of translation in its interior, backwards in the opposite direction on its exterior) sweeps up light particles like coal dust into the air, and might, under favourable conditions, ignite the mixture so formed, and thus give rise to a coal dust explosion?"—Yes; that is a point which has to be experimented upon.

10259. Then you think that it would be impossible absolutely to safeguard the formation of a vortex ring after shot-firing, but that you could put up some small obstacle which would be sufficient to break it up?—Yes.

10260. I suppose some obstacle like a piece of paper, or something of that sort?—No; it would tear the paper.

10261. Then would it form a vortex ring on the other side?—Yes, the vortex ring would go right through it.

10262. It must be some considerable obstacle?—Yes.

10263. In Appendix 2 to your Report on the Universal Colliery explosion there is a further paragraph saying: "When the vortex ring strikes against a screen (constructed of wooden laths fixed to a substantial frame and covered with thick packing paper) placed at a distance of 328 ft. from the mortar, the force of its impact is so great that the paper is torn into shreds which are scattered all over the ground in front of and behind the frame, and the laths, 10 ft. long by 2¼ in. wide by 1½ in. thick, to which the paper is fixed, are frequently broken, and some of the pieces thrown to a distance of over 60 ft." ?—The force of the vortex ring is very great, and in that instance where this method is used in Austria, it is at the distance of 328 ft. or 100 metres that it has these effects. Of course these vortex rings are produced by firing the explosive out of a trumpet-shaped cannon.

10264. Is it quite impossible to prevent the trumpet-shape in the case of a shot-hole?—You cannot tell what shape it is going to take. I have remarked that the mouth of the shot-hole which was supposed to have given rise to the Courrières explosion was, according to the photograph, apparently slightly trumpet-shaped.

10265. So that you think a vortex ring may really have been the cause of the Courrières explosion—that is to say, a vortex ring that only comes once in 10,000 explosions?—Yes; that or less frequently.

10266. But you cannot prevent it coming that once in 10,000 times?—Yes—it might be only once in 1,000,000 times. In the case of the Universal Colliery explosion the shot-hole had assumed a slightly conical form; there was a little ground blown away from the mouth of it, and it was slightly conical in form. I think I call attention to that in my Report on the explosion. But I do not wish to lay any particular stress upon this matter of the vortex ring.

10267. Sir Lindsay Wood suggests that the Commissioners would like to know where you would put the screens in order to prevent the possibility of a vortex ring producing an explosion in this form?—A few planks or a thick prop set up in front of the shot-hole would do that.

10268. You think that could be done?—Yes, quite easily.

10269. And that it should be done and ought to be done?—Well, I do not know; the thing has not been proved sufficiently to say that it ought to be done. One would require to have some experiments made. I thought of suggesting to the Home Secretary that there should be some experiments tried at Woolwich with these vortex rings.

10270. Then you are not absolutely certain that shot-firing in a mine has ever produced a vortex ring at all?—No, not at all; it is only a suggestion on account of the exceeding rarity of shots causing explosions.

10271. (*Sir Lindsay Wood.*) Do you not think the condition of the mine of itself would be sufficient to stop anything of that sort—that is to say the timbers, the galleries, and so on?—Yes, if any of the timber was in the way.

10272. Take the case of the Courrières explosion and test it practically; there was timber and all sorts of things in the way there?—Yes.

10273. And the turns of the roads?—Yes, but it does not require to travel more than perhaps 10 or 15 ft. before it gets at the coal dust; I mean to say the vortex ring need not necessarily go 100 yards; the ordinary flame of the shot, especially with that Favier explosive which was supposed to have been used in the case of Courrières, would not travel perhaps more than a foot or 2 ft. It would only be in the case of a vortex ring being formed that it would carry on a certain distance, but if it carried on perhaps 10 or 12 ft. that might be sufficient.

10274. Not 10 or 12 ft. beyond the place of the accident?—10 or 12 ft. beyond where the shot-hole was.

10275. Then, supposing there was no flame that came from the shot itself, these vibrations you think would be sufficient to set fire to the explosive mixture or dust beyond the shot to the extent of 20 ft.?—No; I think the idea is that the hot gases get into the vortex ring themselves, and are carried along in the vortex ring, which is an exceedingly quickly-revolving ring.

10276. (*Chairman.*) Then those gases would not be visible in the vortex ring?—They might or might not.

10277. They might not be visible at all?—No; with the vortex ring from a locomotive funnel you observe the same steam remains in the ring all the time. Very well, if you get the incandescent gases into that ring of course they remain in it.

10278. (*Sir Lindsay Wood.*) Where would be the light or the heat that would set fire to the gas or anything else that would take fire beyond the 10 ft. or 15 ft.?—You could not have it unless you had coal dust. You see the vortex ring would sweep up the coal dust and mix it with the hot gases at once.

10279. Then it would have no power to set fire to it?—Unless the gases in the vortex ring were incandescent themselves.

10280. But that would not set fire to the coal dust?—Yes, if they were incandescent.

Digitized by Google

10281. It would require very high temperature and a large volume of it ?—Yes, a high temperature.

10282. And large volume ?—Yes, the vortex ring would be a very fair volume. There is an enormous amount of energy coming from a shot, and if the whole energy of a shot were imparted to a vortex ring it would be something very formidable.

10283. You think it is practically possible that such a thing might occur ?—I think it is possible, but I would not be in the least positive upon the point. I think it is a thing that is worth experimenting upon ; that is the furthest I would go.

10284. (*Chairman.*) There would be great difficulty in experimenting with it, because sometimes, as you say, this vortex ring might be visible and sometimes invisible, and if it were invisible it would be very difficult to trace it ? —I mean experimenting with cast-iron shot-holes, the same as they do at Woolwich now, but only to make the cast-iron shot-hole in such a form as to produce a vortex ring.

10285. Do you mean in order to find out what shot-holes do or do not produce a vortex ring ?—They do produce a vortex ring if the hole is trumpet-shaped.

10286. That you know, but what you do not know, apparently, is whether, in making a hole which is not trumpet-shaped, some little accident at the mouth of the hole might make it trumpet-shaped ; that is the point ?—Yes, that is the point.

10287. That a man might just chip away a little bit of the surface at the hole where he put in the shot, and that little chip might make a trumpet-shaped hole which would produce a vortex ring ?—Yes, or that in the position in which the shot-hole was fired it might be slightly trumpet-shaped, that is to say, that the hole might be bored at the bottom of a slightly trumpet-shaped depression in the face, or, supposing the face was perfectly square, in firing the force of the shot itself might excavate the sides of the hole into a trumpet-shaped form. That is what it appears to have done at Courrières, so far as I can make out from the photograph.

10288. So that you are rather of opinion that this ten-thousandth chance may have happened at Courrières, and that by some unfortunate accident the hole from which the shot was fired may have been made in such a form as to produce a vortex ?—Well, I would not go so far as to say that that is my opinion ; I simply put it forward in a very tentative way ; but it is a possibility.

10289. Then your view is that experiments should be made with a view of ascertaining whether it is possible that in shot-firing a vortex ring might be formed ?—That is so.

10290-4. And if a vortex ring is formed, you say there would be danger of an explosion, even although the shot-hole was wetted for 20 yards around ?—Yes ; that is what would have to be tried by experiment—whether there was that danger if a vortex ring was formed.

10295. I see that you express a very decided opinion that coal dust, however inflammable it may be, cannot be made explosive simply by the flame of an ordinary candle or safety lamp ?—Yes, that is quite impossible. If you get a good large flame you can ignite it. I mean to say a flame perhaps six inches high by an inch in diameter.

10296. But you think it has been perfectly ascertained beyond the possibility of a doubt that a mere ordinary flame of a candle or of a safety lamp would not be sufficient to cause coal dust explosions ?—Certainly.

10296A. (*Mr. F. L. Davis.*) That is to say, coal dust without gas, of course ?—Yes, coal dust without gas ; and even a candle flame with gas I do not think would —that is to say, without explosive gas.

10296B. (*Chairman.*) A gob fire again might cause dust explosion ?—No, it would not cause dust explosion unless there was an explosion of gas ignited by the gob fire.

10297. In the case of the gob fire of itself, would not the flame be sufficient if any coal dust came that way ?—No, you have to get the coal dust raised in some way ; the mere fact of a gob fire being there would not cause a coal dust explosion. You have to get the coal dust mixed with the air.

10298. If there was a gob fire burning in a mine, might not some error of ventilation, or something of that sort, occasion a draught of air taking coal dust with it, so as to be carried into the gob fire, and in that way cause explosion ?—No ; no alteration of ventilation would carry enough dust—no ventilating current would carry enough dust to ignite at the gob fire.

10299. (*Mr. F. L. Davis.*) Would it not be very difficult for the dust to get into the gob fire ?—I do not see how it could get into it.

10300. No, the gob fire would be burning or smouldering inside a packed mass ?—You have to dig into the fire before you can get at it—it is inside.

10301. (*Chairman.*) In every case it would be so well surrounded that it would be impossible that any dust could get at it—it would be so packed up ?—Yes, quite.

10302. Then the last paragraph of your Statement deals with the question of steam ?—Yes, I simply mentioned that as I saw it was mentioned by some of the other witnesses.

10303. You think that steam might sometimes be used ?—Yes, it might be useful.

10304. By way of watering mines or by way of diminishing the danger of explosion ?—Yes, it might in some cases where it was convenient. It would be a very expensive method.

10305. You say that "Exhaust steam from a ventilating fan was turned into the downcast at Pochin Colliery, and kept the roads pleasantly damp for some hundreds of yards ; and I have in several instances used steam along with compressed air in underground engines partly to prevent the formation of ice, partly to obtain a better result from the compressed air, and have then observed that the intake airway was damp for a distance of something like 200 yards." Then where you have exhaust steam that you have no particular use for, could you not turn it into a downcast and make use of it in some way ?—Yes, that might be done. Of course there are great objections to things of that kind in many mines, objections one could not always foresee until it was actually done. In the case of the Pochin Colliery the exhaust steam from the fan was turned down the pit, but in the case of a deep pit if you put in steam from the top you would be apt to reverse the ventilation or make it very difficult ; you would require to carry the exhaust steam in pipes right down to the bottom of the pit, and in a deep pit that would be very expensive.

10306. Is there any other matter you would like to deal with, or is there any explanation of your Paper which you would like to give us ?—No, I think I have dealt with all the subjects.

10307. (*Sir Lindsay Wood.*) You have stated that the coal dust explosions are almost entirely confined to the haulage roads ?—Yes.

10308. If precautions were taken to prevent explosions in haulage roads that would go a long way to meet the danger ?—Yes, I think that would practically solve the question. But there are many cases near the face, for instance, in narrow headings where there is sufficient coal dust close to the face to be ignited by a shot, and in fact I have examined one or two cases myself where a shot caused an explosion in a narrow heading—with coal dust.

10309. Are those exceptional ?—They are exceptional.

10310. Very exceptional ?—Yes, quite so. The instance which is most in my mind now is a case in which the coal dust was lying all the way down the heading ; there were no rails and no trams to take the coal away ; it was pushed down the floor of the heading.

10311. Was that before the Shot-firing Regulations were made ?—Yes, that was long ago ; and it was with ordinary gunpowder.

10312. That may be dismissed from our minds at present ?—Yes, I think so.

10313. Generally speaking, there are no explosions in the face caused by coal dust ?—I have never known of any except in a narrow heading.

10314. Then it would be the main roads to which we ought to devote our attention with regard to the question of prevention ?—Yes.

10315. As to the source of these explosions, are they not generally caused by shot-firing ?—Yes, I think so, so far as one can judge. Of course there are many explosions that occur which one never knows the cause of.

10316. If you take the Inspectors' Returns for the last ten years you will find a certain number of explosions have taken place which have been complicated by coal dust ?—Yes.

10317. Can you tell me how many of those have been caused by shot-firing ?—No, I am afraid I could not, because even in the case of the Universal Colliery explosion

Digitized by Google

Prof. W. Galloway.

23 Jan. 1907.

it was not decided where the explosion had started, although I put forward the hypothesis that it was at the place where a shot had been fired.

10318. There have been a certain number of explosions the cause of which has not been determined?—Yes. A certain number of others have been undoubtedly due to shot-firing, and I should think the greater number have been due to that cause; in my opinion, perhaps nine out of every ten at least have been caused by shot-firing.

10319-21. As a fact, during the last ten years there were twenty explosions out of the total number which were caused by and complicated by coal dust. Of those twenty, twelve were caused by shot-firing. I was rather wanting to know whether you could tell me if those explosions were chiefly occasioned in the main roads?—That I do not know. I have not studied them very carefully.

10322. But you said just now that you thought there were very many of them that occurred in the main roads?—Yes.

10323. Therefore if certain things can be done to prevent the fatal effects of shot-firing in main roads it would achieve what we are aiming at?—Yes. The main road is really the carrier of the explosion; when an explosion does occur anywhere in the main road or elsewhere, the main road carries the explosion from one district to another.

10324. Yes, by means of the dust?—The dust in the main road; therefore it is the dust in the main road that has to be considered, and if we could eliminate that, we could prevent the explosion from travelling—we could nip it at its source supposing a slight explosion of gas did occur.

10325-6. But out of the whole of the explosions which have occurred during the last ten years, there are twelve explosions which were complicated by coal dust. You cannot say where those took place?—No, I have not studied these Returns which you are quoting now.

10327. Do you think that thorough watering for 20 yards around the point where a shot is going to be fired, or even further, if necessary, would be sufficient to prevent these great explosions?—Yes. I do not think you require a great deal of watering.

10328. Would that be a more practical way of preventing the explosions than by having a universal system of watering the whole of the wagon ways in all the mines in England and Scotland?—Do you mean to water thoroughly at the site of the shot; I think that is a thing which ought to be instituted at once. I have said already in my evidence, that I did not think the present system of watering where shots were going to be fired was sufficient. Of course, if that were done properly, the probability is that we should not have so many, at any rate, of these great explosions; if that rule were properly carried out I do not think we would have one in ten of the great explosions.

10329. Then you would increase the zone of the watering?—The present zone is ample to my mind.

10330. That is to say, the 20 yards?—The 20 yards is ample—in fact, less than the 20 yards, provided there is no such thing as a vortex ring.

10331. Yes, but I was putting that out of my mind altogether?—Putting aside the vortex ring I think 10 yards would be ample.

10332. Then 20 yards would be sufficient?—20 yards would be quite sufficient.

10333. If the watering was done in a proper manner?—Yes, quite so.

10334. Then, how would you say the watering ought to be done?—I should either carry the water pipes into the place, and water with a hose, or else have some kind of watering tram from which you could use a hose and spray it. For instance, supposing you take a water-tank on wheels, filled two-thirds with water, and one-third with compressed air, then you have a pressure to force the water out with. You can charge it before you go into the face at all, and then with a hose you can spray the water wherever you like—roof, floor, sides, and everywhere.

10335. You mean that the water may be applied all round the area within 20 yards of the shot with a hose?—Yes.

10336. Whether it is got by compressed air or a hand-pump or anything else?—Anything; a hand-pump or a tank in which you compress air by hand, the same as the whitewashing tanks which are used for whitewashing walls, a garden pump, or anything; but not by simply taking a pail and doing it in the way they do it now, that is sprinkling it by hand.

10337-8. What you want to do is to get the dust on the top of the planks of the roof watered as well as they now water the floor?—That is so. If you water for that 10 yards or 15 yards or 20 yards thoroughly, then a shot will never set fire to coal dust, or cause a coal dust explosion—always putting the vortex ring on one side.

10339. Do you think that would reduce very considerably the number of accidents caused by coal dust?—I do.

10340. You think that having closed tubs would prevent the dust coming on to the wagon ways?—Yes; and not filling them up above the top of the sides.

10341. The open tubs are not generally used except where only large coals are sent out to the shaft?—Oh, they are very largely used—not open, perhaps, but with seams between the boards. The seams in the case of the Altofts tubs were not wider than a pennypiece, but that was quite sufficient to let dust out in sufficient quantity to begin to show a sign about 100 yards from the face.

10342. And then it increased from that outwards?—That was all the space through which dust got there.

10343. I suppose you have not actually tested whether there is much more dust coming out of a train of railway trucks than the amount coming out of the tubs in a mine?—Yes, I have observed them.

10344. I mean under the same conditions?—Running along the line I have observed the trains.

10345. In a tunnel?—I have not been actually in the tunnel when the train was there, but I have passed through tunnels frequently through which millions of tons were carried yearly. The tunnel is black no doubt, but there is not a great coating of dust such as there is in a haulage road.

10346. Do you think it would be practicable to put springs and spring buffers to all tubs?—Yes, I have done it myself in certain instances, just to experiment with them.

10347. Take a colliery with 4,000 or 5,000 tubs carrying 6 cwt. each?—Yes.

10348-9. Tubs 2 ft. 6 in. high?—Well, look at the perambulators one sees going along the streets carrying less than half a hundredweight. They are more than 2 ft. 6 in. high.

10350. I say limiting them to that. If you have height you can put a spring on, but if you have no height, you cannot?—It could be done.

10351. At what cost?—It would be rather expensive. I daresay the tubs would cost a half more. I am speaking entirely apart from cost in suggesting springs.

10352. I thought you were; and it is impracticable, I think?—There is nothing impracticable about it.

10353. With a 2 ft. tram, how would you put them on to spring buffers?—It would have to be carefully designed. I do not suppose those little tubs would matter much—it is more especially the large heavy tubs that it would apply to.

10354. Unfortunately there are a great many small tubs which have to go now. With regard to the question of wet zones, do you suggest placing those on the main wagon ways? You suggested that there might be wet zones placed at certain distances in the mine?—Yes. I do not myself approve much of the suggestion of wet zones, but I merely mention what would be the result if there were a wet zone.

10355. You think they are not entirely practicable?—No, I do not think they are. I think it would be better either to wet the whole of the roadway, or to prevent the accumulation of the dust on the whole of the roadway.

10356. Do you think there would be any difficulty in watering the whole length of the roads so as to make them sufficiently wet to stop the coal dust?—No difficulty in mines in which the roof and floor would not be affected.

10357. There is difficulty occasionally in getting water?—Well, I have never found any difficulty in any mines. There is generally enough in the shaft to do that.

10358. I know some collieries which have to buy the water for their engines. Do you think it would be at all practicable to mix the dust on the main roads with some non-inflammable stuff so as to render it non-inflammable—I mean in actual working?—Yes, I do, distinctly. I think that would be a simple way of getting over the difficulty. You have to spread this non-inflammable substance in the same way as the dust itself is spread;

Digitized by Google

that is to say,—if every day you spread a little coating of non-inflammable dust over the dust which had formed on the roads on the previous day, then in course of time you would find that all the dust lying on the roads was uninflammable—just the same as we find in the return airways after a certain time; the coal dust which has been in them to begin with has got mixed so much with shale dust that an explosion does not travel along the return airways; after the lapse of a few years the coal dust in the return airways has got so mixed with shale dust that it is incapable of carrying an explosion.

10359. Many of the fine dusts of shales do carry an explosion?—Well, I take the statement as you make it, but I am not aware of that.

10360. Flour, or any other substance would carry an explosion?—But flour is a very combustible dust: shale is different.

10361. Very fine shale mixtures are combustible?—No, I beg your pardon, shale dust would not carry an explosion. I know Sir Frederick Abel made some experiments in which he thought he got an explosion; but I could have tried them differently and shewn that he had not got it.

10362. (*Mr. Smillie.*) Does that apply in the case of shale which is very rich in oil?—No, not at all. I was referring to shale without any carbon or combustible matter in it.

10363. (*Sir Lindsay Wood.*) Sir Frederick Abel tried a good many experiments upon that point?—Yes. He used magnesia dust I think, and he tried it mixed with gas—not alone.

10364. With both, I think?—I only remember his experiments with gas. He sent me a copy of his Paper and I read it very carefully, and I only remember the experiments with gas.

10365. I see you recommend that the road should be strewn with salt or some other mixture of that character?—Salt or clay dust, or non-inflammable shale dust, or anything of that kind.

10366. I suppose you would probably get some information from the experiments which the London County Council and other County Councils are carrying out for the laying of dust caused by motor-cars?—Yes, very likely.

10367. There are a good many patents being taken out and experiments made with regard to that subject just now?—Yes.—I should not be surprised if something comes out of it.

10368. Do you think those methods will be efficacious?—Do you mean the systems which they are going to use?

10369. Yes?—The only point is this, that if they use anything inflammable it would not do in the case of a coal mine: of course if it kept down the dust that would be sufficient.

10370. You would not get the uninflammable dust on to the timbers of the roof?—No, not if there was something on the floor that would fix the dust the moment it touched the floor, so that each particle when it touched the floor could no longer rise: then it would not get on the timbers at all.

10371. I understand you generally that if shots were either prohibited in the wagon ways, or if the space around the shots for 20 yards was sufficiently saturated with water that would stop the main source of accidents?—Yes, if shots were prohibited not only in the wagon ways, but in every part of the mine except perhaps along the face, or if the ground was properly watered for 20 yards, I think that would prevent by far the greatest number of accidents.

10372. (*Mr. Smillie.*) You say that a mine must be 700 feet or upwards in depth before it can be dry and dusty?—What I meant was that it depends upon the average annual temperature of the locality in which the mine is situate and the rate at which the temperature of the strata increases in going downwards.

10373. That is under natural conditions, of course?—Yes.

10374. There may be steam pipes laid from an engine and carried a considerable distance underground?—Yes

10375. That state of things might alter the condition and change the temperature, might it not?—Yes, distinctly.

10376. So that in a shallow mine it might be unnaturally dry and dusty owing to those conditions?—Yes.

10377. Have you known of cases where that was so?—Yes, I have seen shallow mines where that was so.

10378. Where the temperature was increased by steam pipes—by that artificial means?—Yes.

10379. Are you of opinion that in no case is there sufficient coal dust going down the downcast shaft from the surface to accumulate coal dust at the bottom?—I do not think so.

10380. Where the screening of the coal that is naturally dry and dusty has taken place close to the downcast shaft, you do not think there is sufficient coal dust to cause that?—I think it might give rise to a little trouble in the way of coal dust on the roads.

10381. But of itself you think it would not cause sufficient coal dust to accumulate?—You mean to accumulate in the bottom of the pit?

10382. Yes, or on the roadways?—It might for some little distance in from the bottom of the pit.

10383. But if the tubs and trams which you say are the chief source of mischief were put right, you do not think there would be difficulty?—I think there would be no further trouble.

10384. Could not vortex rings be rendered impossible by merely putting up a strong prop right opposite the shot-hole?—Yes; it would break the vortex ring at once.

10385. Are the smoke rings which come from a locomotive, vortex rings?—Yes, the little steam rings you see flying up in the air.

10386. Can vortex rings only be formed by a trumpet-shaped hole?—That is all. Of course it need not be a perfect trumpet-shape, but you can have a very imperfect vortex ring, perhaps, formed from a very imperfect hole. If you have a perfect trumpet-shaped hole, then you have a perfect vortex ring formed; there are all gradations of perfection. If it is very perfect it could travel a long distance; if it is very imperfect then probably it would do no harm.

10387. The distance which it travels depends upon the force which causes it?—Yes, the force of the explosion.

10388. I think your evidence is chiefly directed to the prevention of the spread of explosions once they take place?—Yes.

10389. I suppose you have no doubt now that all the large and more extensive explosions have been, if not initiated, at least carried on by coal dust?—I have had no doubt of that for the last 30 or 31 years.

10390. That in no case where a large explosion has taken place has it been purely an accumulation of gas which initiated the explosion and carried it through?—No.

10391. There has been no large explosion without an accumulation of coal dust?—That is so.

10392. (*Mr. F. L. Davis.*) I understood you to reply to Sir Lindsay Wood that when you were speaking of the trams and saying that they would be better with springs (and I think we might all agree with that) you were not thinking of the matter of expense at the time?—No.

10393. You were dealing with different ways of preventing the accumulation of dust?—Yes.

10394. But you have had, I think, considerable experience in the actual working and managing of mines in South Wales?—Yes.

10395. Would not the expense entailed, for instance, in having all your trams fitted with springs be very considerable?—About £3 apiece additional; that is for trams carrying from one to two tons.

10396. That is about the average, somewhere about 30 cwt., I think, that the trams carry in South Wales?—Yes.

10397. Is there not considerable difficulty in legislating on this point with regard to any particular type of trams?—Yes, distinctly.

10398. I was not aware until Sir Lindsay Wood mentioned it just now that the tubs in his part of the country are so very small. But the conditions vary so much in every part of the country, that it would be very difficult to legislate for any particular type of tub or tram?—It would.

10399. Or to say that they were all to possess certain springs?—Yes, it would be very difficult.

Digitized by Google

Prof. W. Galloway.

23 Jan. 1907.

10400. I think you said that of the two ways of watering—the spray system and the hose system—at any rate in Wales, the spray has practically gone out?—Yes. I have not seen a spray for a long time now in Wales; everyone is using the hose now, I think.

10401. Do you know from your experience that very often the men themselves used to turn off those sprays?—Yes, because in passing the spray it comes against your clothes and wets you very much.

10402. I know that is one of the difficulties our managers have experienced with regard to that?—Yes.

10403. I think generally the system in use in Wales is the hose, placed at certain distances—a certain length of hose?—Yes.

10404. I gather from your evidence given this morning that you do not agree with a good many of the inspectors who have been before us and who say that it is necessary to thoroughly water the roof, sides and floor?—No. I think that opinion in nearly every case has arisen from the fact that the gentlemen who express it have never seen a well-watered road or a properly-watered road or a road that had been continuously watered for a certain period of time, say, for three months. They have seen roads which have been watered spasmodically.

10405. They may also never have seen all the different conditions in different mines after a thorough watering?—No—that is what I meant. For instance, Mr. Stokes' remarks about this heap of dry dust struck me very much, because it is an impossibility to have a heap of dry dust in a road if watering has been continuous, say, for two or three months; and it is the same with the dust on the timbers.

10406. Would there not be great difficulty in many seams, at any rate, in the South Wales district where you watered so thoroughly roof, sides and floor?—Great difficulty from what?

10407. From squeeze?—Certainly.

10408. And by falls of roof?—Yes, it would be practically fatal to some mines. I know of one instance which I have in my mind where a mine was ruined in about five months by injudicious watering; it cost thousands of pounds to re-open roadways only some 1,000 yards long.

10409. Of course we see the difference in different seams in the same company's pits?—Yes, quite so.

10410. I put it to you whether it is not practically impossible to formulate any clause which would fairly deal with the question of watering all the mines in one district, to say nothing of the whole country?—Yes. But you can give an alternative.

10411. You might have exceptions. You might have a clause which would deal with the matter generally, and then have exceptions?—Yes.

10412. But the exceptions, I put it to you, would be so numerous, and of such a different nature, that it would be almost impossible to get anything which would apply generally?—Yes, it is somewhat similar to the Shot-firing Rules: in the Shot-firing Rules there are so many different ways of doing things, and it would be the same with this watering or preventing the accumulation of dust, or whatever was decided upon. I think that the law could be made to meet the whole of the cases.

10413. Do you happen to know whether or not the cost of timbering in South Wales is greater than in any other district of the country?—Yes, I should think it was. It is very expensive in some seams.

10414. Would you say that if you were thoroughly to water, as has been suggested by some of the Inspectors, the cost of timbering would be considerably increased?—In some seams: but there are some seams in which watering can be carried on without any special increase: I do not say that they would be the majority—possibly they would be in the minority.

10415. I should agree that there would be some seams in which practically no difference would be made, but in the majority of seams the cost would be increased considerably?—Yes, I should think the majority in South Wales; and in some it would be impossible.

10416. With regard to your suggestion of sprinkling a non-inflammable dust with the coal dust so as to prevent there being present a dust which is explosive, have you gone in any way into the proportion of that dust which you would mix with the coal dust?—I made experiments with lycopodium and chalk dust some seven years ago; I do not remember the exact figures, but I think it had to be mixed in about equal proportions, the lycopodium dust and the chalk dust.

10417. That I presume would necessitate using very much more of that dust, supposing you used that to start with, when you began to use it, because there is always an accumulation of dust in the roads in the mines: at first you would have to use rather a heavy quantity of that?—Yes, or else clean the road from one end to the other to start with, and then commence, as it were, to use it from day to day.

10418. But you have not been able to make any experiments with that actually in a coal mine to any large extent?—No, because really it would tell you nothing: I mean to say, one might begin to do it on one's own account to prevent an explosion the same as one would commence to water; but you cannot experiment with it in a mine.

10419. You might never have the explosion?—Exactly.

10420. Do you think you can get on in working coal mines without shot-firing at all?—No.

10421. Under the present regulations as to shot-firing (I say the present regulations, possibly with one or two extensions or restrictions) if they are properly carried out, should we not have a state of things in which the number of explosions would be decreasing?—Certainly. I quite agree with that.

10422. I do not know whether I have made myself quite clear?—Yes, I understand what you mean.

10423. That if the existing regulations for shot-firing were always strictly carried out, we should save a very large amount of explosions?—I am quite of that opinion.

10424. If that is the case, does it not come to this really, that if those restrictions were carried out strictly—I say that they may be added to a little in one or two directions, and possibly there might be still further watering—if they were carried out strictly, that would be really a better safeguard than dealing with the tubs or the dust which exists at present by any of these other methods of dealing with coal dust?—Yes, I believe the number of explosions would have been reduced to one-tenth of what they have been if the watering regulations had been carried out properly.

10425. Really that is, I think, generally considered to be the source of the explosion?—That is so.

10426. If we can do anything to prevent the explosion from starting, we shall not want to trouble so much about the coal dust or the travelling ways?—Not so much; but then, of course, there is always this other point, that if an explosion of fire-damp caused by a defective safety lamp occurs, and the coal dust is there in the main roads, the explosion will travel through the colliery.

10427. That is very much more generally accepted now than it was?—Yes.

10428. Do you happen to know the number of accidents that there have been, I will say, in the last 10 years on an average from explosions, and the number from falls of roof and sides?—I have seen all the figures, but I do not happen to carry them in my mind.

10429. I think I am right in saying that there are six and-a-half times as many accidents from falls of roof and sides as there are from explosions?—Yes. Of course the number of explosions has been greatly reduced within the last 20 years. That shows that the precautions which have been taken have tended to reduce them.

10430. I quite agree?—And no doubt further precautions will reduce them still further. I never think that any argument based upon the relative number of accidents from different cases has anything to do with it; I mean to say, explosions we ought to deal with by themselves, whatever the number of accidents from falls of roof may be, because explosions, I think, are more easily stopped than any other class of accidents if the regulations are properly carried out.

10431. That is to say, really in the way in which you have answered my question with regard to shot-firing?—Yes.

10432. (*Mr. Enoch Edwards.*) In answering Mr. Davis just now you said you did not think it was possible to get on and to work mines without shot-firing?—Yes.

10433. Can you give us any reason for that?—Yes—very good reason.

10434. Will you do so. I understood you to say that you could not get coals and work them without shot-firing?—No, I meant you could not carry on mining without shot-firing—I did not say get coals.

10435. I misunderstood you?—I referred to mining generally, and I was thinking of hard ground.

Digitized by Google

10436. I quite agree. In getting coal generally where the men go to the coal face you would not say it is not possible to get coal in that way without shot-firing?—No, I think you could get coal without shot-firing in such cases. It would be a matter of expense in some cases. Of course, in some parts of the country and in some seams of coal it is necessary to do blasting.

10437. Of course it is cheaper?—Yes, it is cheaper.

10438. There are no other reasons, are there?—No, there is no other reason.

(*Mr. F. L. Davis.*) Is it not easier for the workmen?

10439. (*Mr. Enoch Edwards.*) Well, I do not know. I have known cases in which colliery people have taken courage in their hands, and have decided that they would not have a shot fired in the place; it has cost them a little more, but not so much more when they got used to it. Of course you agree coals can be got without shot-firing?—Yes.

10440-1. And the difference in cost would not be so much after all?—Well, I do not know what the difference in cost might be, but it is certain that coals can be and are got without shot-firing.

10442. Very large quantities of them?—Yes—most of it, I should think.

10443. And for those reasons—because there is risk in shot-firing?—No, for the reason that shot-firing is not required. There is no shot-firing required in any of the Welsh steam coal mines.

10444. But I put it to you now rather within the knowledge of my own experience that there are seams of coal where shot-firing would be of assistance to the workmen and where they would get coal more easily, in which the colliery people themselves decline to blast at all, and it is done in the interest of the safety of the pit entirely?—Yes, I daresay that is so.

10445. And they gather their coal without very much extra cost?—I have no doubt it is so.

10446. The explosions arise from two sources generally, namely, gas or coal dust?—Yes.

10447. If you render harmless all noxious gases, according to the present General Rule, and take away coal dust there is no danger of explosion in the pit?—None.

10448. What did you mean by the defective safety-lamp which you referred to in answering Mr. Davis?—I meant a lamp in which the wire gauze cylinder or any of the washers have been left out, or in which there is a hole in the gauze larger than there ought to be, or which has not got a shield, or anything of that kind.

10449. Of course I understand you do not suggest that that would fire coal dust?—No—it was a firedamp explosion I mentioned in connection with the defective safety-lamp.

10450. But the rule suggests, to begin with, that at all times there should be sufficient ventilation to dilute the gas and render it harmless?—Yes.

10451. If that rule is carried out where is your fear of explosion?—It is quite impossible occasionally to prevent the accumulation of a little gas: I mean to say you could not carry on mining practically without now and then having a little gas in some corner or other of the workings.

10452. I suppose you will agree from your experience that there is nothing like the accumulation of gas in pits now that there was 30 years ago?—No, but I have seen a good deal of gas not so very long ago.

10453. Not recently?—Well, it is impossible to prevent it now and then. Supposing an accident occurs to a brattice or a door, or anything of that kind, you have got the gas and you must remove it.

10454. Assuming there is a breakdown in the ordinary machinery which regulates it?—Yes, then you get the gas, and then you may have the explosion if you have a defective lamp.

10455. I am very anxious to follow this as a practical question, so as to know what is the best thing to do; and you have had very considerable experience; I understand you to suggest that in watering roadways everybody is pretty generally agreed now that the danger and the risk is accentuated because of the aggravation of dust in roadways. You think it is not possible to brick-arch the roadways?—With what object?

10456. Well, in some of the seams we get an amount of roof coal beyond the timbers, and there is percolating damp through the roadways?—Yes.

10457. I gather you would prevent that?—Yes, in the case of a seam that was left behind on the roof.

10458. A seam immediately over it?—You could prevent it by arching in that case, but that is a rare case.

10459. Your attention has been directed very strongly to watering; has it ever occurred to you that it is possible to keep the main haulage roads clear and free from dust without watering?—Yes.

10460. Assuming the haulage road is a mile long, if that method is followed consistently and persistently, the cost of keeping it free from dust would not be very great—without watering?—No; that is my opinion.

10461. If you were setting out a plant of your own now with your present knowledge, would you be inclined to try that method?—If it was my own mine I should; but I should not be disposed to try it in someone else's mine.

10462. But do you think it would be possible to keep it free of dust?—Certainly.

10463. (*Dr. Haldane.*) At the beginning of your statement you say there is generally insufficient dust at the working faces to initiate or carry on an explosion, except in the case of very brittle coal. Would you include in "very brittle coal" most of the coal which is worked in South Wales—the steam coal particularly?—No.

10464. Is it not the general experience that the Welsh explosions do traverse the working faces?—Yes, they traverse the working faces on account of dust taken in from the roads; that is to say, the roads contain dust, and the explosion carries the dust into the working faces. That is my opinion with regard to it. I have examined a great many of them.

10465. You think that the flame which traverses the working places, the face, is produced by dust?—Yes, from the roads.

10466. That is to say, it is carried right in by the explosion?—Yes. Of course it gets some dust at the face as well, but I think a portion of the dust is carried in by the explosion.

10467. It sometimes travels a pretty long way round a long wall face, does it not?—Well, not round a face. There is a road every 15 yards with dust in it, and of course that road gives its quota of dust to the explosion that is travelling along; what I mean is that it does not travel along the face independently of the roads. If you look at the plan of the Universal Colliery in the Report on the explosion you will observe there is a road every short distance there communicating with the face. You must treat it as a whole; you cannot take the face as one thing and the road as another—because they are all combined, as it were.

10468. You think the explosion in those cases may have come up each heading separately?—What I mean is that the air in the whole district gets full of coal dust from roads and faces and one thing and another. Of course the face produces some of the coal dust, undoubtedly, but the roadways principally.

10469. Then have you any explanation to give why in most explosions in the North of England the explosion does not penetrate the face in the same way as in South Wales?—In the case at Altofts, to which I refer, it was simply because there was no coal dust in the roads at the face.

10470. Do you think that was the case in other explosions—for instance, Seaham? Perhaps you do not know about that case?—I went to see Seaham after the explosion of 1882, I think it was, but I simply saw the place where the shot was fired, and the state of the dust in the roads. I was not a *persona grata* when I went there; it was just about the time of the commencement of the agitation with regard to coal dust—so that I did not get as far as the faces.

10471. In your statement with regard to dust in the roadways at Altofts Colliery, you say that the quantity of dust increased from the face towards the downcast shaft?—Yes.

10472. Are you pretty well convinced that that increase is not due to dust being carried down the shaft itself from the surface?—Quite.

10473. You think it is from the wagons?—I am absolutely certain. You can see it on the roads; you can see where it begins, and you can see it getting blacker and blacker between the rails, and for a few inches outside the rails; it is as clear as anything can be where that dust comes from. You would see it in the main roadways if it was coming from the screens, but you do not.

10474. I thought you said you did?—No; I mean you would see it in the air in the main roadways if it was coming

Digitized by Google

Prof. W. Galloway.

23 Jan. 1907.

down the pit from the screens. No doubt some comes down, but I mean to say the great bulk of it is produced from the trams and the wagons.

10475. Certainly the coarse dust on the roads must be, but I thought the fine dust on the timbers might very well be due to dust being carried down the shaft ?—Some of it possibly, but very little comparatively.

10476. You mention the cost of watering in the case of the Hibernia Company ; that is a very large company, is it not ?—Very large.

10477. I mean to say that is the cost of watering a number of pits ?—Four or five mines.

10478. And very large ones ?—Yes, very large. Of course I only mention that in order to show what expense people will go to in order to obtain safety.

10479. Yes, but the actual cost of putting up and maintaining the water appliances comes out to not a large sum per ton of coal, does it ?—No, the maintaining of the watering does not come to much.

10480. And erecting ?—And erecting. Of course if you only charge so much depreciation and interest, it does not come to a great deal—indeed very little.

10481. It would be about 1d. per ton, would it not ?—Yes, or less, I should think.

10482. (*Mr. F. L. Davis.*) It depends upon the number of tons whether it is much or not ?—Yes, it depends upon the number of tons.

10483. (*Dr. Haldane.*) Can you give us any instance of any colliery that we could see in which watering on the floor only is carried out ? You have mentioned that when watering of the floor only is properly carried out continuously throughout the mine, there is no dust practically to be found on the timbers ?—No.

10484. That is a very important point, and it is a thing which I think the members of the Commission would be very desirous of seeing, if possible ?—The only mines which used to be watered like that were the Glamorgan Coal Company's mines. I can ascertain from Mr. Hood whether he carries out his watering as efficiently as he used to do.

10485. Were they watered by trams ?—They were watered by trams at that time ; now I think they have pipes and hose. If you would like to go and see it I will make enquiries on the subject.

10486. Personally I should very much like to see a mine in which the floor only is watered, and where it is done thoroughly ?—I will ascertain and let you know.

10487. Yes, I think it is a very important point ?—It is.

10488. I suppose you are not of opinion that a zone of watered floor, say 100 yards or 200 yards long, would stop an explosion ?—Yes, I think a zone would stop an explosion.

10489. But now dust is surely carried in the air along an intake haulage road ?—Yes.

10490. It would be carried from the dusty parts on the road and deposited on the timbers in the watered part ?—Yes ; but we were supposing that the timbers were watered in the zone.

10491. If you have a watered zone you would say that you must water the timbers, the floor, and everything else ; that is the point ?—Yes—or arch it.

10492. You mentioned cases in which explosions have been stopped, apparently, at the entrance to a district in which the floor of the road was more or less damp ?—Yes.

10493. I know there are also cases recorded in which an explosion travelled apparently over a damp floor. I do not know whether you have examined any of those cases ?—I have seen cases in which the explosion travelled over areas of dampness.

10494. It looks as if the damp floor were not at all a certain method of stopping an explosion ?—I think if there was no dust on the timbers and the floor were damp for a certain distance, that would be quite sufficient.

10495. Yes, if there was no damp on the timbers ?—You must not have dust anywhere if you wish to stop the explosion.

10496. For instance, in the case of the Park Slip Explosion, there is a map published with the Inspector's Report, which shows that the explosion travelled up the Slip over a damp area for some distance (*Map produced*) ?—Yes.

10497. That is an area which is marked as damp on the floor. The damp on the floor is marked with an interrupted blue line (*Pointing out on drawing*) ?—Yes.

10498. I think the explosion was supposed to have started down here and to have travelled up the Slip (*Pointing*) ?—Yes ; then you must have had dust on the timbers.

10499. You would explain that in that way, I suppose ?—Yes, undoubtedly.

10500. (*Mr. F. L. Davis.*) What is the distance of the damp area ?—It is about 7 chains—150 yards.

10501. (*Dr. Haldane.*) With regard to your suggestion as to some indifferent substance like clay dust being mixed with the coal dust, do you think it is of importance to carry out experiments upon that point ?—I do, most distinctly.

10502. You are aware of no actual experience which would throw light on the subject except your own experiments with lycopodium ?—That is so, but the fact remains that in most of the return airways the explosion does not travel, and that is simply due to the fact that the coal dust has become mixed with shale dust.

10503. There is usually very little coal dust in a return airway, is there not ?—Well, it does not matter how little there is if there was originally enough to carry on an explosion, and if that has been rendered innocuous by the mixing with shale dust.

10504. That is a point which could be pretty easily ascertained by experiment, could it not ?—Yes, very easily determined.

10505. With regard to damage to roads by watering, I think you take a rather serious view of the damage which would be likely to be produced by watering in Wales, do you not ?—Yes, in some seams.

10506. You are aware, I suppose, that watering has been practiced universally in Westphalia for some years ?—Not universally.

10507. Well, in all the dangerous seams, practically ?—I thought there were a great many exceptions in the case of seams which would not stand watering.

10508. We tried the other day to find the exceptional ones, the difficult ones, and we could not come across them. There were one or two in which they were asking to be exempted, but they were very exceptional, and we were rather surprised to find that this was so. I am wondering whether you are not taking too serious a view of the damage which might be produced by watering ?—I am perfectly certain that in some seams it would be quite impossible to water—I mean to say you could not keep the workings open without having more men keeping the roadways open than the number employed in working coal ; it would be impossible to do it.

10509. You have seen instances of very serious damage ?—Yes ; I know it is so.

10510. What sort of watering was that ?—It was very injudicious watering with a hose laid on hard, the same as some of the Inspectors were advocating in their evidence. I complained about it over and over again to the Manager that too much water was being put on, still it was continued, and every time I went to the colliery I found the same thing—the roads swimming.—In the course of about four or five months the colliery began to collapse ; in fact it was going on all the time, but in four or five months it became so bad that the watering had to be stopped.

10511. Was it the floor that gave way ?—Everything seemed to give way : the watering had to be stopped.

10512. Of course in Westphalia they are very careful not to put on a great deal of water, but they do it with a hose ?—Yes. That was done with a hose also. But of course when you put a hose into the hands of a man you cannot foretell what he is going to do with it.

10513. Is there not this to be said, that everybody sees what he is doing, and suffers from the effects of it if he does not do it properly ?—Well, he thinks the more water he puts on the better.

10514. Do you not think that he is sure to get into trouble if he puts on too much water ?—No—you cannot trust them.

(*Chairman.*) I see that in your Report, Dr. Haldane, with reference to watering you say, in Paragraph 35, sub-section 2 : " The watering of roads for haulage, travelling and ventilation, including self-acting inclines, must be carried out by specially appointed and responsible men who must be furnished by the manager or his substitute with a written notice exactly defining his duties."

Digitized by Google

(*Dr. Haldane.*) Yes, that is the German Regulation.

(*Witness.*) I should think they would need to be very responsible men; that is my experience of it.

10515. We did not notice that the roads were bad for avelling, or that there was very much water lying on them, or very much mud, or anything of that sort?—No.

10516. (*Mr. Smillie.*) In regard to such a case as you mentioned just now of a mine where excessive watering practically closed it, supposing that mine had been naturally wet do you mean to say it could not have been worked?—I do not know. I often wondered how these seams would have been if they had been near the outcrop—whether the strata, being naturally wet to begin with, would have stood better. I think they probably would have stood a great deal better if they had been naturally wet to begin with, but being very dry when the water was put on, the water told, and in the act of absorbing the water they seemed to swell.

10517. (*Dr. Haldane.*) I think they had some experience of that sort in Westphalia, when the watering was first introduced. That is my impression, but the trouble disappeared usually very soon. You cannot give us any instances that you know of damage that we could see in Welsh collieries, can you?—Do you mean due to this watering?

10518. Yes.—No, not now.

10519. Can you give us a case of any colliery in regard to which we could get evidence on the subject from the Manager?—I could not. I daresay most of the Managers have ceased to cause any damage from watering.

10520. But watering is very general in Wales, is it not?—I can hardly say that. There are pipes in many of the mines and there is a good deal of watering done. I have no doubt in seams in which it does not do any damage, watering is done regularly; but in seams where damage is done I should think the watering is not carried out so efficiently; one would not expect it.

10521. (*Chairman.*) You think the mine owners are somewhat too cautious with regard to causing damage, and that they might very well water more than they do, even although slight damage might be caused by it?—I do not think I will go as far as that. I think I have found the mine owners as a rule very anxious to carry out what is safe for the mines.

10522. I rather understood that was what you meant?—No, I do not mean that they do not water on account of a little damage. I think it is only where it would be serious that they do not water.

10523. But I thought you said they did not water as much as you thought was desirable, because of the damage. Was not that your answer?—That is what I meant; I meant that they did not water as much as was desirable from a safety point of view on account of the damage.

10524. And that you thought there was a good deal to be said from their point of view because watering produces damage?—Yes, it would make mines unremunerative in a good many cases.

10525. But still at the same time you are of opinion that if one has only regard to safety, watering might be carried on to a greater extent than it is at present?—Yes, distinctly.

10526. (*Dr. Haldane.*) In the case of the explosion at Clydach Vale the mine is stated to have been watered on the day before the explosion?—Yes.

10527. And yet the flames spread all through the mine?—Yes.

10528. I should like to ask whether you have formed any opinion as to what the explanation of that was?—Yes, the amount of watering had not been sufficient.

10529. You think it dried up, probably?—Partly that, and partly that there was not enough put on to start with, perhaps; they may have been afraid of damaging the mine by putting on too much.

10530. You did not examine that mine, did you? You were not down the pit?—Not until afterwards.

10531. Because that is rather a striking example of a mine exploding which was apparently watered?—Yes, but you can always be quite sure that there was sufficient dust there to carry on the explosion if the explosion travelled through the mine.

10532. (*Chairman.*) With regard to coal screens causing dust very often to come down the downcast shaft, Mr. Walker was examined on the point, and he suggested that the screening of the coal should take place at least 100 yards from the shaft; he also said that in the Cadeby Main Colliery there were fans and pipes for exhausting the dust from the screens in use, and he thought that was a very good plan?—Yes.

10533. He further said, in answer to Q. 3573; "I was down a mine the other day where they put in some steam jets—it had been very dusty—and those steam jets had been on only about three months, and there was very little dust—it had been damped and fallen into the bottom of the shaft and cleaned out at the week-end." Do you think that would be a good way of dealing with dust from the screens?—I do not think steam jets would. I have put up fans to extract the dust from screens at two different collieries, and found that it could be done quite well by extracting the dust from the screens and collecting it in a chamber.

10534. Then you do not think that a system of jetting or spraying the downcast shaft would be necessary: you think the dust might be dealt with before it got to the shaft?—Yes. I think a system of jetting or spraying the downcast shaft would be a clumsy way of doing it.

10535. One of your objections to the present system of watering would appear to be that it is often carried out very inefficiently: or, rather, very ignorantly?—Yes. I do not think it is often carried out efficiently.

10536. Do you not think that where mines are watered it would be desirable to adopt the German practice of having specially appointed and responsible men to do it?—Yes, distinctly.

10537. Now, I suppose, it is left almost to anybody, is it?—Yes, the most ignorant labourer in the mine is possibly the man who is put on to do that kind of work because of his cheapness.

10538. I should have thought that was rather an economy which would be perhaps expensive in the long run, and I should have thought it would have paid the mine owners to have employed a good man to do that sort of thing?—So it would, but the manager very often simply appoints the cheapest man he can find to do these things, which is a great mistake.

10539. You would say that a mine manager who did that was acting in a penny wise and pound foolish manner?—Quite so.

10540. But still in your experience there are such managers?—Yes.

10541. You think that one reason why the watering of mines has not always turned out to be a success is that ignorant and inefficient persons are entrusted with the duty of watering them?—That is my experience.

10542. It seems that in Germany they insist on the working face being to some extent watered. Dr. Haldane, Mr. Hall and Mr. Atkinson have said that on the whole they thought it would be undesirable for them to suggest that there should be watering of the face; and that you agree with, I suppose?—Yes.

10543. I suppose you would agree with them also that watering according to the German Rules is somewhat excessive, and that such watering only might be made compulsory in the case of haulage roads—that is to say, not in every place?—Yes.

10544. So that you think the Germans go further than you would be prepared to suggest in regard to watering, that is to say, that the Germans insist upon watering any places, such as the working places and also such as the ventilating airways, where you would suggest watering is not required?—Yes.

Digitized by Google

Mr. ALBERT MAYON HENSHAW, called and examined.

Mr. A. M. Henshaw.

23 Jan. 1907.

10545. (*Chairman.*) You are Director and General Manager of the Talk o'th Hill Colliery, Stoke-on-Trent, a member of the Institution of Civil Engineers, a Fellow of the Geological Society, Past President of the North Staffs. Institute of Mining Engineers, also Past President of the North Staffs. Colliery Owners' Association, and a member of the Board of Examiners, Stafford District?—Yes.

10546. With regard to the summary of evidence that you have put in, what I propose is that it should be printed at the top of your evidence, with numbered paragraphs as you put it in, and then we can refer to the numbers of the paragraphs in any question we ask you, so that it will not be necessary in all cases to put in the evidence for a second time the wording of your paragraphs. We can refer to such and such a paragraph, and then ask you questions upon it, and if anyone wants to know the exact wording of the paragraph he can look at the Report at the beginning of your evidence?—Yes.

(*The Witness handed in the following Statement.*)

GENERAL OBSERVATIONS.

(1) Coal dust increases the violence of an explosion when present with a small percentage of firedamp. It is capable of initiating and extending an explosion by itself under certain conditions. A coal dust explosion is accompanied by violence corresponding closely with a fire-damp explosion.

(2) A coal dust explosion cannot be directly produced by the flame of an ordinary open light or insecure lamp. It is not likely to be directly caused by an underground fire. Coal dust may be ignited by the detonation of a firedamp explosion or the improper discharge of a blasting explosive, or under some circumstances by an exceptionally heavy shot as was the case at Altofts.

(3) In many explosions, coal dust has been the chief cause of devastation and loss of life. In some cases coal dust has been the only cause, for instance in the Seaham, Altofts, Camerton, Courrières, and Wingate explosions.

(4) Coal dust explosions are not easily produced, or explosions would have been more frequent and more disastrous—particularly prior to the use of permitted explosives.

(5) Coal dust explosions are generally the result of irregularity or carelessness in the use of explosives or safety lamps. If we can prevent the ignition of fire-damp thus caused, we shall minimise the dangers of coal dust.

(6) The subject of coal dust and its bearing on explosions is little understood. There is still much scepticism and perplexity amongst prominent mining people. It has not had the scientific attention its importance demands.

(7) Mr. Hall's experiments in old pit shafts with gunpowder were conclusive up to a point, but the conditions and results left much to be desired. Some other experimenters have failed to ignite coal dust.

(8) I urge that further practical experiments on a large scale are necessary for the purpose of arriving at some definite conclusions as a basis for precautionary measures.

(9) Coal dust dangers are, however, so generally admitted that precautionary measures are necessary in all dry and dusty mines.

EXPLOSIVE PROPERTY OF COAL DUST.

(10) The inflammability or explosive property of coal dust is a matter of degree, depending upon purity, fineness, dryness, quantity, volume of air, and many other conditions not yet understood.

(11) To be explosive, coal dust must be very fine and very dry.

(12) I suggest that coal dust containing impurities showing on analysis over 45 per cent. ash is not explosive.

(13) I suggest that coal dust, sufficiently pure, capable of passing through a screen of 784 meshes to the square inch (safety lamp gauze) is explosive.

(14) Sufficient data to determine a standard of dangerous dust does not exist.

(15) I have made many analyses of explosive and non-explosive dusts.

(16) I have analysed numerous samples of dust from the Courrières Mines. I had the privilege of examining these mines after the explosion in the company of Mr. Atkinson, and with him collected the samples of dust. I hand in a statement* of these analyses together with a plan showing the route of the explosion and where samples were taken. The figures show where the non-inflammable character of dust stopped the explosion. The plan shows where the explosion was stopped by a wet road.

(17) I analysed samples of dust collected after the explosion at Talk o'th Hill Colliery in 1901. I hand in a statement of the analyses.* The figures show non-inflammable dust which stopped the explosion. The plan shows a wet road which stopped the explosion.

(18) I am strongly of the opinion that 100 yards of wet road will stop a coal dust explosion. An explosion of dust once commenced immediately raises a dust cloud which is carried forward by the force of the blast at great velocity. I believe that flame is chiefly supported in the forepart of the cloud in the dust where the necessary air is present. The immediate result of the flame and combustion of dust and distilled gas and air is that an atmosphere of afterdamp or products of combustion is generated in the body of the cloud so that explosive combustion or flame cannot be supported in the after part of the cloud or behind it. Therefore on arriving at a point where the road is free from dust, violent flame ceases in the absence of new dust because of the burnt condition of the dust being carried in the forepart and the insufficiency of oxygen in the body of the cloud. I have come to the conclusion, from observation, that a dust flame is easily stopped if the dust is not continuous, or by non-inflammable dust, or a wet road. Violence ceases almost immediately with the cessation of flame, and I have observed numerous instances where the damage to roads ended almost immediately beyond the limit of flame. At Courrières this was particularly the case at the point shown on the plan by the analysis figures Nos. 3, 10 and 20, and also at A, B and C, and beyond the wet place in the South bowette 326. The same cessation of violence was observed at Talk, at the points shown on the plan by the analysis figures Nos. 11, 16, 13, 14 and 18, and also at the points A, B, C and D, where the dust flame ceased. Also at other places in other seams.

HOW AND WHERE COAL DUST IS PRODUCED.

AT THE WORKING FACE.

(19) Hard coal generally produces less dust than soft coal. Thin seams less than thick seams, shallow seams less than deep seams. Many seams produce no dangerous dust at the face.

(20) Method of working has much to do with production of dust. Where the "holing" is in the underclay, less dust is produced. Where much shale is removed with the seam, dust is mixed with inert matter, and often rendered non-inflammable. The longwall system produces least dust. Pillar and Stall produces most dust by the cutting of headings and crushing of pillars. An advancing longwall face is generally less dusty than a retreating longwall face. Headings or roads made in solid coal produce dust.

(21) Coal cutting machines produce more dust than hand work. Coal cutting machines are the most productive cause of dust at the face.

(22) Production of dust at the face is unavoidable, though no part of a colliery varies so much in this respect. Dust made at the face remains at the face or is eventually buried in the goaf. It is not carried into the roads or airways to any serious extent. Dust produced at the face is often of a coarse description, only a certain percentage being of the impalpable character which is most dangerous.

(23) The removal of dust from the face is impossible.

(24) Conditions at the face being so extremely varied, it is impracticable to apply any uniform or universal measures of precaution.

* *See* Appendix I.

Digitized by Google

(25) Explosions traverse faces much less extensively than roads. In many cases explosions after travelling roads by means of coal dust have not extended to the face. I know of very few cases in the United Kingdom where a coal dust explosion originated by coal dust at the face.

(26) If proper care is taken with regard to blasting and use of safety-lamps, I do not apprehend serious coal dust dangers at the face.

(27) If precaution is necessary, watering is the only possible one.

(28) Watering at the face is rarely necessary. It could not be universally applied owing to the varied conditions. It would be difficult to decide exemptions. It would generally increase danger from falls. In many cases of soft clay floors, watering would disturb props, chocks, and packs, and bring down the roof. There are exceptional seams where such danger would not be materially increased. In seeking to escape one danger a greater would be introduced, namely, fatalities due to falls of roof and sides. (Average deaths by explosion, 1896–1905 inclusive, 72 per annum. Average deaths by falls, 1896–1905 inclusive, 479 per annum). I know seams where the naturally wet condition of the floor prevents working except at prohibitive cost and risk; after trial the seams were abandoned. Water would render the working of some seams impossible, by depreciating the quality of the coal, such as soft seams, which owing to the dust most require watering if necessary at all. It is most difficult to saturate a mass of newly-cut coal with water, to ensure raising no dust when moved, without excessive flooding.

(29) There are many seams where water at the face would produce gob fires, owing to the rapid disintegration and oxidation of moist waste coal in the goaf.

(30) Watering extensively in deep and consequently hot mines (North Staff. 900 yards) is quite impracticable. A hot saturated atmosphere is injurious to health. This has been proved in deep mining in Belgium.

(31) Ankylostomiasis would probably result from universal watering at the face.

(32) Conclusion. Watering at the face is not necessary. Face dust is not generally dangerous. Watering to damp effectually fine coal must be excessive. Excessive watering increases danger from falls, and depreciates the quality of the coal. The real danger at the face is firedamp, which can be minimised by proper care as to ventilation, lamps, and blasting.

(33) Exception. One possible exception may be conceived: a long continuous longwall face cut by machinery and excessively dusty where shot-firing is necessary. In such case it might be advisable to divide the face into sections by a watered space of 100 yards, with the corresponding connecting roadway also watered.

Dust in Roadways.

(34) Chiefly produced by coal and shale shaken from the top of tubs and through holes and joints, and also falling from the roof and sides: this is ground into dust on the floor by the trampling of men and horses. Dust blown by the air current from the top of passing tubs. Dust carried down by the air current from the screens at the surface.

(35) The most dusty roads are those along which coal is conveyed, and of these, roads in solid coal are more dusty than roads in goaf or longwall; in the former case coal falls from sides, and in the latter, shale.

(36) Travelling roads are not generally dangerously dusty, except roads in solid coal. The dust in travelling roads is principally shale from attrition of feet on the floor. These roads are not subject to the dangerous dust of haulage roads.

(37) Airways are not generally dangerously dusty. They are not subject to the dangerous dust of haulage roads, and dust from the faces is not carried into airways to any serious extent. Dust in airways is largely composed of shale. Explosions rarely traverse airways.

(38) Face gate-roads are not dangerously dusty. The dust is granular and coarse and mixed with shale from the making and repairing of the road. They are comparatively new roads, and do not contain the impalpable dust of old main roads. Explosions which traverse main roads frequently stop on reaching face roads.

(39) Horse roads are not often dangerously dusty. Their dust is mixed with shale from the floor caused by the feet of horses. Such roads are secondary roads, and the velocity of the air current does not seriously blow impalpable dust from passing tubs. Horse roads are more often subject to repairs and admixture with shale dust.

(40) Main roads, on which mechanical haulage is used, are longer in use, and subject to accumulations of very fine dust behind timbers in crevices. They are subject to wastage of coal from passing tubs and to dust blown from tubs by the air current which here is at high velocities.

(41) Main and tail, and direct systems of haulage are most productive of dust because of high speed, shaking of tubs, and moving quickly against the air current.

(42) The endless rope system of haulage produces least dust. The motion is slow and easy, but such roads being the main arteries of the pit along which all traffic passes, they are subject to accumulations of dust everywhere.

(43) All main haulage roads when dry contain dangerous dust by long use, much traffic, and large volume of air. The dust is carried and deposited on all surface and in all sheltered corners.

(44) Most dust is found on main roads at junctions where the different haulage systems converge and traffic is concentrated, and tubs are stopped, started and marshalled. There is greater waste from the tubs, and more trampling by the feet of workmen.

(45) Dust from screens is dangerous dust, but this is not a common source of dust.

(46) Where large outputs are elaborately screened close to a dry shaft taking in a large volume of air, dust is introduced into the mine, and in some cases dust collecting arrangements as described by Mr. Walker and Mr. Gerrard may be advisable at the screens.

(47) The majority of shafts are sufficiently wet to saturate the air and deposit dust from the surface on the sides of the shaft, in the sump, or near the pit bottom where it is trodden to a hard surface.

(48) Sprays in the shaft to saturate the air, and partitions between the screens and shaft would provide the necessary security in the majority of cases.

(49) Removal of Dust from Roads is impracticable on a sufficiently large scale to remove the cause of danger.

(50) Prevention of Dust in roads.—It is possible to reduce the amount of dust by the use of dust-proof tubs maintained in such repair as to prevent loss of contents. I have adopted such a tub, and hand in a sketch (*see* Qu. 10607). The bottom is of steel plate, flanged upwards at the sides to receive the side boards; the ends are of steel, also flanged to receive the side boards. The side boards are of Karri-wood. They have been in use two years, and are very satisfactory.

(51) Loaders at the face should be strictly enjoined not to put fine coal on the tops of tubs.

(52) Roads should be more frequently cleaned by loading up loose rubbish from the floor.

(53) Sweeping sides and roof and white-washing by means of lime-washing machine at junctions, sidings, and other important parts of main roads, tend to reduce the quantity of dust.

(54) Watering of Roads.—It is impracticable to apply rules for universal watering. Conditions vary so extremely between no dust and very dusty.

(55) Watering of ordinary roads would disturb the strata and timbering, and increase the danger from falls. In some cases maintenance under wet conditions would be impossible. In exceptional cases there may be no injury. It is impossible to conceive more dangerous conditions than ordinarily made and ordinarily timbered roads in broken strata, with all surfaces in a wet and slippery state. Deaths due to falls are already 6½ times more than deaths due to explosions. Apart from such danger, the cost of maintenance of many roads under such conditions would be prohibitive.

(56) If proper care of lamps and explosives is exercised, such drastic measures as universal watering are not necessary.

(57) Coal dust dangers may be reduced to minimum by more moderate precautions than universal watering.

Isolation by Watered Spaces.

(58) It is possible to limit or prevent the extension of a coal dust explosion by dividing the workings into sections separated by watered spaces on main roads.

Digitized by Google

Mr. A. M. Henshaw.

23 Jan. 1907.

I hand in a diagrammatic plan to illustrate the suggestion of isolation by watered spaces (*see* Plate III, Qu. 10638).

(59) Such spaces should be arranged according to circumstances at:—Main entrances to districts at the face end of haulage roads. Main junctions of haulage roads. Near pit where main roads from different districts converge.

(60) Roads should be specially prepared for the purpose when necessary. Arched with brickwork, walled with brickwork at the sides, closely timbered, cemented or boarded at the sides. The floor paved with bricks.

(61) 100 yards of such wet road would arrest the flame of a coal dust explosion.

(62) Airways would not usually require to be so treated.

(63) Travelling roads would not usually require to be so treated.

METHOD OF WATERING ROADS.

(64) Jets of water under pressure I have found unsatisfactory. The water is not sufficiently diffused, and the orifices become blocked. Saturation of the air is not complete unless a number are employed, when flooding of the floor is excessive.

(65) Jets of water with compressed air I have found more satisfactory. Sketch handed in (*see* Qu. 10668). The air and water are regulated as required by their respective valves, and the water may be taken from a pipe-main or tank. This jet gives a cloud of vapourised water. Five jets spaced 40 yards apart showed by the hygrometer saturation of the air current over nearly 300 yards, and the surfaces of the air were thoroughly damp. A number of workmen complained of discomfort near by and in passing.

(66) Sprinkling by hose pipe from taps 25 yards apart on main pipe. The result was satisfactory. Roads so treated were a pair of stone drifts each 100 yards long in strong strata. The sides and roof were roughly dressed and lime washed. The floor cleaned and sprinkled with salt; 30 cwts. of salt being used per 100 yards. The road was sprayed with water once a day, which kept the surfaces damp, and free from dust. The road was frequently cleaned, the sides swept and new salt laid every three months.

(67) Similar spaces were similarly treated in road closely timbered and boarded behind the timbers. The result was satisfactory, but great care was necessary with more frequent and light sprinkling to avoid disturbance.

(68) Sprinkling with hose pipe will be the most generally practicable method of watering.

(69) Removing dust by compressed air. I have used a jet of compressed air with flexible hose in removing dust from road before watering. This plan is very effectual, but the dust is carried into the workings beyond. I tried to arrest this dust by a water screen of several jets, but not effectually.

(70) Precautions against coal dust are proper and necessary, but rules should be reasonable. We must not forget that more strict observance of present rules would have prevented many coal dust disasters. Irregularities in shot-firing and the use of safety lamps are most responsible. We have had instances of the improper use of explosives such as, blasting out old timbering in main roads; blasting old machinery in pit; blasting large stones on floor from falls; excessive charges—fast shots—blown out shots. There have been 106 explosions due to shot-firing in the past 10 years.

(71) Shot-firing is the most dangerous of all operations in mines. The present Act, special rules and Statutory Orders are too complex and confusing, especially to many under officials and the workmen who have to carry out the law in the pit. The rules could be much simplified if brought together and redrawn. Greater security has resulted since the institution of Government tests and the Permitted Explosives List, but there is still room for great improvements in flameless explosives. The tests should be more severe and more exhaustive before they are passed as safe. It disturbs confidence when explosives are "permitted" and then withdrawn after being in use as "safe" for months. I suggest that the weight of explosive used in any one shot in dry and dusty places should be limited. Experiments show that danger increases with the weight of charge. The written permission of the manager or under-manager should be required for every shot in dry and dusty roads. Rules are required as to the length of stemming necessary to ensure safety against blown out shots. Rules are required as to holing, freeing or dressing of the face before a shot is allowed, for the prevention of blown out or "fast" shots.

(72) *Safety Lamps.*—Forty-nine explosions during the past 10 years have been traced to defective or improper use of safety lamps. Government tests are required of different types of safety lamps. No lamp with a single gauze should be allowed. The maximum length and diameter of gauze or the cubic contents of the interior of a lamp, including the glass space, should be defined.

COAL DUST TESTS.

(73) Tests of Courrières dust with Favier powder were made in the Belgian Gallery at Frameries, and ignitions of dust were obtained. The gallery was only 30 metres long, and to many people the results not convincing. A Statement is handed in of some of these experiments. The whole subject of coal dust calls for scientific investigation and practical experiments on a large scale. I urge strongly the establishment of a Government testing station. The gallery should be 600 to 800 yards long for the purpose of testing various dusts from districts and seams, quantity, quality, mixtures with shale and inert material. Further tests of permitted explosives in dust, firedamp, &c., should be carried out to determine some standard of safety. The gallery would be useful for testing the value of dust-free or wet spaces and for experiments with rescue apparatus, &c. It would be sufficient to begin with a gallery 200 yards long, and extend as experiments suggest.

EXPERIMENTS WITH COURRIÈRES DUST AT FRAMERIES.

Since the Courrières disaster, experiments have been made with Favier powder and Josephine coal dust at the Experimental Gallery at Frameries, placed at the disposal of the Courrières Company by the Belgian Government. The experiments were made under the direction of M. Léon and others, and demonstrated beyond question the exceedingly inflammable nature of the dust and its ready ignition. The dust used was from the Lecœuvre heading, Veine Josephine, where the explosion originated.

The gallery is of oval shape, 2 m. wide inside, and 30 m. long, with relief doors at the top, and 16 observation windows at the side. At the closed end, and on the lower side, is fixed a cannon 0·50 m. long and 55 m/m. diameter, inclined so that its axis meets the roof of the gallery at a distance of 7 m. The dust was put into suspension by means of two small fans, 3·75 m. and 14 m. from the cannon. In the interior of the tube were placed six frames of fir and oak at the following distances: 4·40 m., 10·80 m., 16·30 m., 18 m., 17·80 m., and 21·55 m. A few of the experiments only need be given.

Experiment No. 1.—Charge, 400 grms. Favier Explosive No. 1, with no dust or fire-damp. Flame was observed as far as the second window, or 2 m. from the cannon. Mechanical effect, slight.

Experiment No. 3.—Charge, 200 grms. Favier No. 1 and 6 kgrs. of dust, put into suspension by the first fan. No flame observed.

Experiment No. 4.—Charge, 300 grms. Favier No. 1 and 6 kgrs. dust. No flame observed.

Experiment No. 5.—No. 3 repeated. Flame observed for 20 m. The first frame disturbed. Coke or charred dust began at 0·60 m., and extended as far as 12 m.

Experiment No. 7.—Charge, 400 grms. Favier No. 1. The dust of a preceding experiment was left, and a new quantity of 6 kgrs. put into suspension by each fan.

The flame leapt out of the tube 2 m. and retired. There seemed to be two successive flames at the windows 13, 14, 15 and 16. The first and fourth frames were displaced. Coke was deposited as far as 18 metres, and was found on both sides of the frames.

Experiment No. 8.—Charge, 400 grms. Favier No. 1. 2 kgrs. dust put into suspension by the second fan, which was afterwards stopped. 3 kgrs. spread by a hand sieve for 9 metres, and 3 kgrs. put into motion by the first fan. Flame shot out of the gallery 7 metres, and coke was deposited on the whole length of the gallery. The frames were intact, but the sixth was burnt.

Experiment No. 19.—Charge, 500 grms. Favier No. 1. 3 kgrs. dust on the last 9 metres; 3 kgrs. put into suspension by each fan. A ventilating pipe from Courrières was wedged obliquely against the top part of the gallery, its centre being 7 metres from the cannon.

Digitized by Google

Digitized by Google

ROYAL COMMISSION ON MINES.

COAL DUST

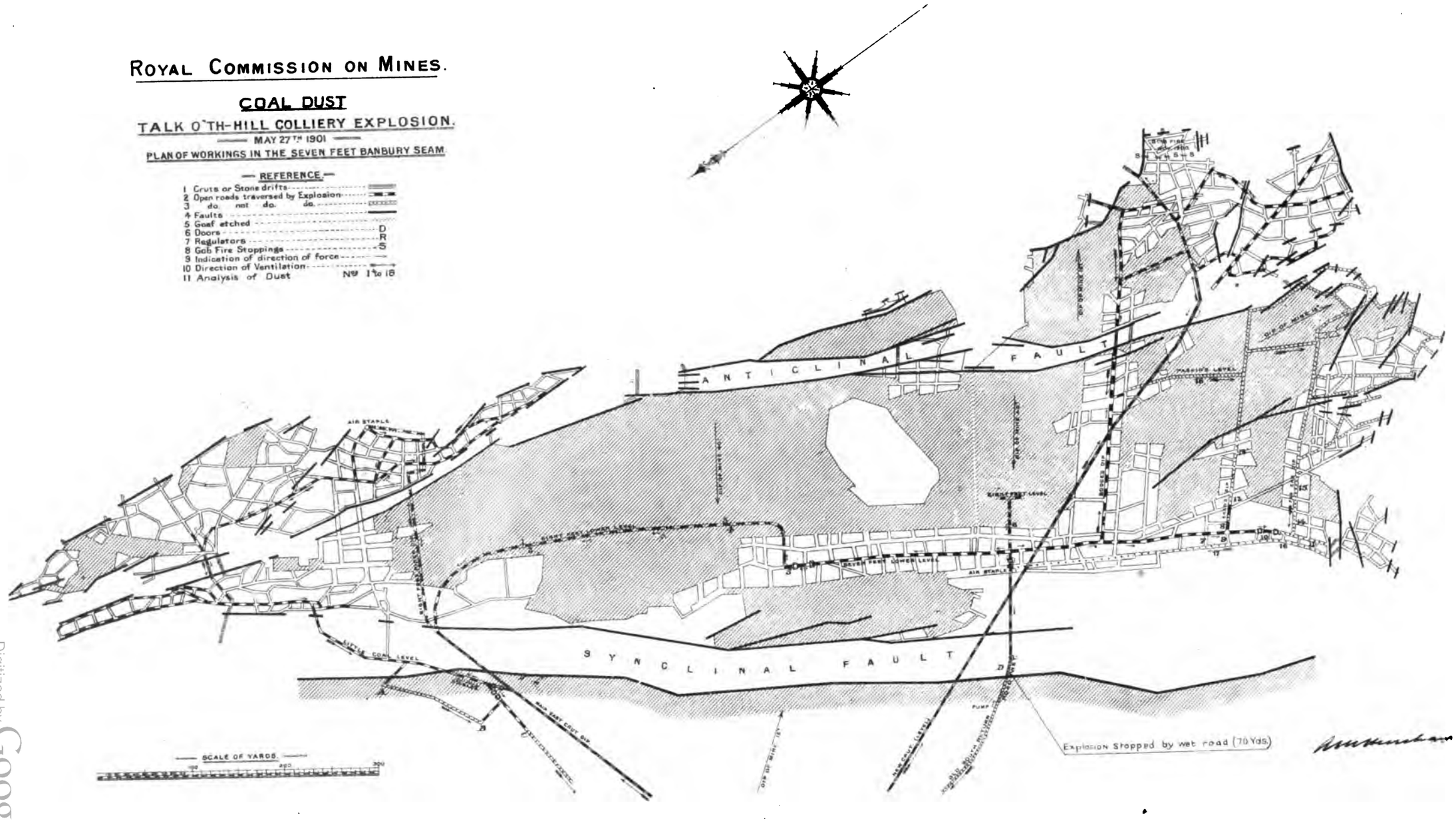
TALK O'TH-HILL COLLIERY EXPLOSION.

MAY 27TH 1901

PLAN OF WORKINGS IN THE SEVEN FEET BANBURY SEAM.

— REFERENCE. —

1 Cruts or Stone drifts
2 Open roads traversed by Explosion
3 do. not do. do.
4 Faults
5 Goaf etched
6 Doors — D
7 Regulators — R
8 Gob Fire Stoppings — S
9 Indication of direction of force
10 Direction of Ventilation
11 Analysis of Dust — Nos 1 to 18



Digitized by Google

Miller & Graham, Ltd Litho London.

Digitized by Google

I

Digitized by Google

Litho. London

A wooden tub from Courrières was placed in the gallery at 6·50 m. from the entrance. A disc of paper closed the end of the tube. Flame shot out of the gallery more than 15 metres, and set the grass on fire on the slopes. The tub was projected outside 4 metres, and partly destroyed. A clot of liquid tar was observed 5 or 6 metres from the end of the gallery. Coke was deposited over the whole length, but was less abundant than in some previous experiments, less sticky, and more spongy. It was deposited on the sides of the frames facing the cannon. The frames were intact, except the first and third. The pipe had fallen, and was slightly damaged at the end.

10547. (*Chairman.*) You first of all deal with the general question of coal dust explosions, and you give it as your opinion that coal dust increases the violence of the explosion when present with a small percentage of firedamp, and is alone capable of initiating and extending an explosion under certain conditions, and that a coal dust explosion is accompanied by violence corresponding closely with firedamp explosions. You go on to say in paragraph 2 that coal dust explosion cannot be produced by the flame of an ordinary open light or insecure lamp. That has been also the opinion expressed by Professor Galloway and other witnesses who have been examined before us, but I do not quite understand how you reconcile that statement with paragraph 5 where you say coal dust explosions are generally caused by irregularity or carelessness in use of explosives or safety lamps. If the flame of the safety lamp will not itself cause an explosion, how are coal dust explosions caused by carelessness in the use of safety lamps ?—By the careless use of a safety lamp, or the use of an insecure safety lamp, firedamp explosions are initiated, and the firedamp explosion originates the coal-dust explosion. That is what I mean there.

10548. The presence of a naked light or an insecure lamp in coal dust itself will do no harm ?—I think not.

10549-53. If the coal dust is mixed up with firedamp there will be an explosion ?—I think the introduction of a large flame in a dense cloud of coal dust might even start an explosion. There has been an instance of the kind at Brancepeth in Durham some years ago, and evidence of that was given before the last Royal Commission on Coal Dust in Mines. There three men who were sent to clean out a hopper went into the hopper with a torch lamp, one of the men going to the bottom of the hopper with the lamp, and the others at the top brushing the dust down on him set up a large flame and an ignition of the coal dust which amounted to an explosion, and I think killed the three men, but such conditions are not likely to be met with in the mine.

10554. You go on to deal with the explosive property of coal dust, and you say that some of the conditions are not yet understood ?—Yes.

10555. And several times in the course of your evidence you say it would be very desirable that further experiments should be conducted with a view to finding out the exact properties coal dust makes explosive ?—Yes.

10556-8. It is generally admitted that very fine and very dry coal dust is specially explosive, and it must be very fine and very dry to be explosive, or moderately fine at all events. Then in Paragraph 12 you suggest that dust containing impurities showing an analysis over 45 per cent. ash is not explosive. Have you gone into that matter thoroughly ?—Yes, I draw that deduction from analyses which I have made of coal dust from two explosions, in particular the Courrières explosion and the Talk o' th Hill Colliery explosion.

10559. In Paragraph 18 you say you consider that 100 yards is a sufficiently wet zone to stop an explosion ?—Yes.

10560. How do you come to that conclusion ? What has induced you to come to that conclusion ?—I think perhaps it would be as well to refer to two plans which I have here.* There is a very remarkable instance here (*Indicating on Plate I.*) of the explosion at Courrières being stopped by a wet road. To explain as shortly as I can, the explosion began *here* by a blown-out shot, and traversed these roads which I am following with my pencil (*Indicating on plan*) by this main road through *that* pit in a direct line in this main stone drift. At *this* point it branched in two directions east and west—the most likely direction would be straight forward, but at this point the road was wet for 60 metres.

10561. It must have gone with terrific force ?—Yes, I should think there was as much violence in this road as anywhere to be found in the pits.

10562. (*Dr. Haldane.*) Is that the intake road ?—Yes.

10563. (*Chairman.*) It had the opportunity of diverging. You would not know what would have happened if that had not been there, a wet zone and another road here ?—Yes, that of course weakens the force at that point. Beyond this point the roads were dusty. They were haulage roads, and in these two districts of Josephine and Adelaide there were the 13 men who came out 20 days after the explosion, where they were working, and they escaped. That wet road saved the lives of those men, and others would have been saved had they remained in their places.

10564. There is nothing in the Courrières mine to say what would be the effect of an explosion that had not any means of proceeding except through a wet zone, whether a wet zone of 60 metres would have succeeded in stopping it under those circumstances ?—I think that is sufficient.

10565. It shows, no doubt, the wet zone had a very great effect ?—Yes.

10566. At the same time the explosion there had a chance of breaking off in *that* direction and *that* direction, of which it availed itself ?—Yes.

10567. (*Mr. Smillie.*) It was dry and dusty ?—I think it would have been equally effectual in stopping the explosion if there had not been the side roads.

(*Chairman.*) The side roads would not make any difference.

(*Dr. Haldane.*) An ordinary colliery explosion often goes right past the shaft.

(*Chairman.*) My point is that it had an opportunity when it found a resistance owing to a wet road, or nothing to go upon owing to a wet road, and that then it found a congenial atmosphere for itself in that direction. Supposing there had been no roads here at all the force must have expended itself straight on in that direction. Supposing it had expended itself straight on, would it not possibly have got through so many yards of wet and got on here ?

(*Mr. Enoch Edwards.*) There is nothing to feed it.

(*Mr. Smillie.*) It is want of something to feed it.

(*The Witness.*) Want of combustible matter and also the cooling effect of 60 metres of wet road.

10568. (*Dr. Haldane.*) Was that road wet in the roof ?—Yes, I think it was wet all over.

10569. And the roof and sides ?—It had been so wet that to clear the water a bore hole had been put down from the side of the road to some deeper workings to a pump.

10570. (*Mr. Enoch Edwards.*) That has not been watered ?—No, it was naturally wet from the strata. It was not flooded, but in a wet condition generally.

10571. (*Chairman.*) After 60 metres it was dry again ?—Yes.

10572. (*Sir Lindsay Wood.*) It came past the shaft ?—Yes.

10573. (*Dr. Haldane.*) Were there horses all right in this part, do you know ?—I do not know.

10574. Some of the men walked into the afterdamp ?—Most of the men from the Josephine walked into the afterdamp and were found on the way to the pit. The party who stayed in were rescued after 20 days. That is my answer to that question as to the wet road. (*Producing another plan, Plate II.*) I have another instance of an explosion being stopped by a wet road at the Talk o' th Hill Colliery. This was a very clear case indeed. The explosion came from the workings of the 8 ft. *here* and traversed this stone drift to the 7 ft. This road was continuous beyond 7 ft. into a main return airway. The flame traversed that road up to point D, at which point the road was wet for 70 yards.

10575. (*Dr. Haldane.*) Is that return a haulage road ?—It was not then a haulage road, but had been formerly, and had only been discontinued a very short time, so that the road was, in my opinion, in a sufficiently dusty condition to transmit flame. The explosion stopped at the wet place.

10576. (*Chairman.*) After the 70 yards it was dry again ?—Quite dry again. Then in another direction the explosion was stopped at the main downcast shaft. At the bottom of the main downcast shaft there would be not more than 30 yards of wet surface of road, and on both sides of the pit the roads were dusty. The explosion travelled to the shaft and failed to cross the wet part to

* *See* Plates I. and II.

Digitized by Google

Mr. A. M. Henshaw.

23 Jan. 1907.

the other side of the pit. Here, again, of course, you get a sort of safety valve at the pit shaft and some release of pressure which may have had something to do with it, but I came to the conclusion that the wet road had stopped the explosion passing across the pit to the workings beyond.

10577. Then you go on to say something about how and where coal dust is produced, and you suggest precautions. You say that the method of working has much to do with the production of dust, and that the longwall system produces less dust than the pillar and stall. Would you suggest that any preference should be given to the longwall system, and that it should be required to be adopted rather than the pillar and stall?—No. The question of the method of working a seam of coal depends upon many other conditions economical and important outside. I do not think it would be possible to prescribe either method universally.

10578. You say that coal-cutting machines produce more dust than hand work. Would you suggest any limit should be placed upon the coal-cutting machines, or that certain machines should be used rather than certain other machines?—No, I think that also would be quite impracticable.

10579. The dust produced at the face only produces a certain percentage of impalpable and dangerous dust?—It is, of course, of a granular description generally, and not so likely to propagate a flame as this impalpable dust found in main roads.

10580. In Paragraph 23 you say removal of dust from the face is impossible. You would not suggest that there should be any system of watering carried out at the face itself?—This refers to removal only. I say the removal of dust is impossible.

10581. Removal being impossible, would you deal with it in any other way, either by watering or any other way?—No.

10582. Not at the face?—No. There is a paragraph later on referring to watering of the face in which my reasons are given, and then you will see what I say in Paragraph 25 about the explosion very rarely traversing the face; that is a well-known fact. The great danger at the face is fire-damp and not dust.

10583. The dust causes the explosion to be much worse than it otherwise would be?—Decidedly. If you stop the ignition of fire-damp you stop very much the propagation of a dust explosion from the face.

10584. You say that there is a great difference between the haulage roads and the travelling roads that are not used for the purpose of haulage?—Yes.

10585. You say explosions often fail to traverse airways?—You have passed Paragraph 28 as to the watering at the face. With regard to watering at the face I should like to point out one fact here. During the past 10 years the deaths due to falls at the face are 3,195; deaths due to falls on roads 1,577. The proportion is as two is to one, so that if you do anything at the face by watering to bring about insecurity of the timber of the roof and so on, you aggravate very much this very serious state of things.

10586. You go on to say what roads are not apt to be dangerous from dust, and then with regard to main roads, you say they are subject to wastage of coal from tubs, and to dust blown from tubs by air current at high velocities. That you imagine is a very serious danger, and that it would be best to have some kind of tubs that do not lend themselves to scattering coal about?—Certainly, tubs that will not lend themselves to scattering the contents through holes and between spaces, between boards and so on, but I do not see how it is practicable to adopt a tub with a cover to prevent the dust from being blown from the upper surface.

10587. Would you suggest that it would be inadvisable to load the tubs above the top, because as they go along there would be a great deal of dust shaken off if you load very high?—I do not agree with that. The tubs when they are loaded above the top are loaded with large pieces, and not with small coal.

10588. Does the coal not break off sometimes, and do you not have dust from those large pieces?—Very rarely.

10589. You do not see any objection to loading tubs up above the surface?—No.

10590. With regard to the shaking of tubs: I suppose if you had springs to these tubs that would reduce the shaking to a considerable extent. Would you suggest that?—No, it would be quite impracticable. There are a large number of tubs in use at a colliery.

10591. In Paragraph 42 you say "Endless rope haulage produces less dust." Would you make any rule that this system of haulage should be adopted?—I think it would be impossible to make a rule. Many collieries are not adapted to endless rope haulage. The roads are too circuitous, and endless rope haulage would be impossible.

10592. Where it could be fairly easily applied you think it should be applied?—I remark that it is, from the point of view of producing dust, the best system of haulage.

10593. I suppose where it can be adopted, where the angles of the road are such that you can have fairly easily an endless rope haulage, that probably would be not only the least dangerous but the cheapest and best means of haulage road?—Yes, that follows naturally nowadays. It is the best mining practice to adopt endless rope haulage, and wherever the conditions allow that is generally done.

10594. In Paragraph 43 you say all main haulage roads when dry contain dangerous dust?—Yes, I think that is correct.

10595. You say that most of the dust is found on main roads at junctions, where different haulage systems converge and traffic is concentrated, and you go on to deal with dust from screens which you say is dangerous dust, but not a common source of dust. That would depend entirely upon the colliery, whether there is screening going on close to the shaft. There might be a considerable amount of screen dust going down?—I say where there are large outputs elaborately screened close to a dry shaft taking in a large volume of air, that the production of dust is considerable and is carried some distance into the workings, but that only applies to a few of the larger collieries where the installation of dust collecting arrangements at the screens would be perhaps advisable. Such plans, for instance, as were mentioned and illustrated by Mr. Walker and Mr. Gerrard in their evidence; those plants are very good of their kind, and in such cases advisable.

10596. You sometimes have the dust collecting arrangements at the screens, and sometimes apparently you would have sprays in the shaft to saturate the air?—Yes.

10597. That would sometimes be a good way of dealing with it?—Yes.

10598. Sometimes there is one mode of dealing with it, and sometimes another?—Yes, the sprays in the shaft to saturate the air going down the shaft, combined with partitions between the screens and the top of the shaft would, very often, remedy the evil.

10599. At the same time you say in Paragraph 49, removal of dust from roads is impracticable on a sufficiently large scale to remove cause of danger?—You must deal with it in some way.

10600-1. You say that the dust on the main haulage roads must be dealt with in some way besides being removed? It cannot be removed entirely, and you cannot prevent it getting there entirely?—That is so.

10602. Consequently in the main haulage roads there will be accumulations of dust, whatever you do, and they will have to be dealt with in the same way?—Yes.

10603. I suppose if you cannot remove the dust the only way to deal with it would be by watering?—Yes, which I go on to explain, by watering spaces and isolating parts of the pit from each other.

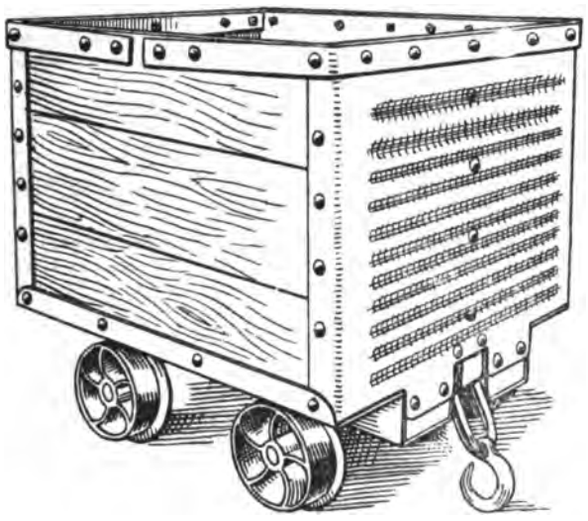
10604. We will take it in order now. I go to Paragraph 50, prevention of dust in roads. You say it is possible to reduce the amount of dust by having these dust-proof tubs?—Yes.

10605. You advise dust-proof tubs?—I do.

10606. Do you think they should be universally used and that it should be made obligatory to have dust-proof tubs in collieries?—I do not know whether I would make it obligatory or not, but I think when the danger of coal dust is more generally realised, there will not be much difficulty about the introduction of a better class of tubs down our mines.

Digitized by Google

10607. In your colliery, Talk o' th Hill, have you these tubs?—Yes. I will hand you a sketch of one:



10608. They are always in use; none others are used?—We have about two-thirds of the whole number now made upon that plan.

10609. I suppose you are using up the old tubs? Is that the reason they are not all like this?—Yes, we are using up the old tubs and converting them.

10610. Directly they are used up you will have all these new tubs. You will not have any more old tubs?—Exactly, because where you have nearly 2,000 tubs it is a big outlay to do it at once, and you could not call upon colliery people to adopt a new type of tub immediately. It would have to be a work of time.

10611. Then in Paragraph 51 you suggest that the loaders at the face should be strictly enjoined not to put fine coal on the top of the tub. Then you say, roads more frequently cleaned and sides and roof swept and white-washed, and so on. Now, with regard to watering, you begin by saying it is impracticable to apply universal watering, and that the watering of ordinarily made roads would disturb strata and timbering, and increase danger from falls. What do you mean by "ordinarily made" and "ordinarily timbered roads"? Do you mean roads that are not bricked?—No, I mean the general class of road you find in an ordinary colliery. Stone drifts and arched roadways of course would not suffer very much from watering, generally speaking, but the ordinary road made in the coal seam or through the goaf and timbered in the ordinary way would certainly not stand watering throughout, that is to say, floor, roof and sides.

10612. As regards the watering of the floor alone, do you think that could be done in many cases without any great harm to the road, if it was confined to the floor and not applied to the sides?—I think it would be quite useless to confine the water to the floor; sides and roof must be watered if the dust is to be properly reduced.

10613. We have had evidence from Professor Galloway that, in his opinion, watering of the floor with watering of the floor alone would be fairly efficacious. His theory was that the dust along the roads would almost certainly find its way sooner or later, or a good deal of it would, at all events, fall to the floor, and directly it got on to a wet floor it would be perfectly innocuous. He thought a good deal might be done in the way of watering the floor, although it might be impracticable to water the sides and roof. You do not agree with that?—No. I think where you have the floor wet you often find a considerable amount of dust on the ledges of the sides between the timbers and over the timbers. To be effectual, watering must be thorough.

10614. That is exactly the point. What do you mean by "thorough"? How much watering would you say was necessary to be effective?—Sufficient to keep the surfaces of the road in a damp condition, so that dry dust cannot be found on the surfaces or the ledges of the road. I do not suggest watering such as I describe universally, but in certain spaces so as to isolate the pit into sections.

10615. You would have watering by zones, in fact?—Yes.

10616. In those zones you say the watering should be thorough?—Yes.

10617. We have had some evidence to show that a very small amount of watering will stop an explosion. For instance, it has been stated that water accidentally splashed from the buckets when taking water to the horses has been known to stop an explosion, and water accidentally splashed from a pump containing water also has been known to stop an explosion?—I have never known of such a case, and I can hardly conceive that ordinary splashing from a bucket or a tub on a roadway would stop a coal dust explosion.

10618. You say even if the watering of ordinary main roads could be carried into effect, apart from the danger the cost of the maintenance of many roads under such conditions would be prohibitive?—Yes.

10619. You say "many roads." I suppose there are a large number of roads in which that would not apply, in which it would not be so very expensive?—Yes, but I am referring to the ordinary road.

10620. The ordinary conditions?—Yes, the ordinary conditions of roads in the pit; 90 per cent. of the roads.

(*Mr. Ratcliffe Ellis.*) In Paragraph 55 the witness says "in broken strata."

10621. (*Chairman.*) "And ordinarily timbered road in broken strata." Is that the condition?—Yes.

(*Mr. Ratcliffe Ellis.*) It would be especially dangerous.

10622. (*Chairman.*) You would not have 90 per cent. of the roads in broken strata?—All roads are more or less in broken strata.

10623. (*Mr. Enoch Edwards.*) How do you reconcile that with your statement that you believe in it being thoroughly watered?—Roads, to be thoroughly watered, must be specially prepared. I have mentioned that later.

10624. Not such roads as those?—No. In making that statement I had in my mind a certain colliery, and I made an estimate of what I considered the cost of universal watering at that colliery would mean. The installation of pipes and the labour in sprinkling would probably not come to more than the figures give in the Report on the Westphalian Collieries, but the most serious cost is the maintenance of the roads afterwards. I take such a colliery having 20,000 yards of roadways underground: that colliery would be equal to an output of about 250,000 tons of coal per annum. It is easily conceivable that the result of watering would mean the repairing of those roads at least once per annum thoroughly. That repair would probably cost 10s. per yard, which is equal to 10d. per ton of the output of the coal—maintenance cost.

(*Chairman.*) You take it, at all events in this particular colliery, that the expense of carrying out a thorough system of watering such as obtains in Germany would be 10d. per ton?

10625. (*Mr. Ratcliffe Ellis.*) I understand that is in excess of the ordinary expense?—In excess of the cost of installation; the cost of maintenance afterwards would be at the rate of 10d. per ton.

10626. (*Chairman.*) Maintenance alone. There are tables in Dr. Haldane's Report giving the expense as anything between 2d. and 2½d., and less than 1d.?—That is the cost of installation only.

(*Mr. Ratcliffe Ellis.*) What would be the normal expense of the road as compared with the 10d.?

10627. (*Chairman.*) I thought you meant 10d. extra?—10d. extra for the colliery I have in mind, which is a bad colliery, and I give that figure.

10628. It would not apply to many collieries?—No. I give that figure to show what, in my opinion, it would cost to certain collieries.

10629. (*Mr. Wm. Abraham.*) Do you mean to say that in your opinion to thoroughly wet the road in that colliery would increase the cost by 10d. per ton?—Every road in that colliery thoroughly watered and kept in a saturated condition from the pit to the face would mean 10d. per ton on the output of that particular colliery, and I give that as an instance of what universal watering would mean to some collieries. That is an extreme case, and the figures given in the Westphalian Report deal only with the cost of the installation of the pipes and the labour in watering. My figure goes beyond that and gives the cost afterwards of maintaining the roads which are damaged by such watering.

Digitized by Google

Mr. A. M. Henshaw. 23 Jan 1907.

10630. (*Chairman.*) That would be in addition to this cost of 2d., or whatever it may be. You first of all have a cost of 2d. per ton as the interest on the money that was expended in the first installation, which would amount perhaps to 1d. or 2d. per ton, and then a further 10d. for keeping up the roads?—Yes.

10631. In your opinion it would cost something like 10d. extra?—Yes, in one case.

10632. That is an unusual case?—I give that as an unusual case, showing how unfair it would be to propose universal watering for all collieries.

10633. What would you suggest as being a fairly typical expenditure in typical collieries which were neither very difficult nor very easy collieries to deal with in the matter of watering?—Probably nearly half that figure.

10634. That would be about 6d.?—4d. or 5d. per ton.

10635. In your opinion there would be few mines in which it would be advantageous that it should be done, even independently of the cost?—Yes, very few.

10636. If you looked at it simply from the point of view of the safety of the miners, and did not think about the cost at all, would you suggest that more watering should be done than is done at present?—I should. I should suggest that at every dry and dusty pit some precaution should be taken. Those precautions I set out later.

10637. You go on to the care of lamps and explosives, and say that if proper care of lamps and explosives were taken, universal watering would not be necessary. You think that a good deal might be done in that way?—Yes.

10638. Then you go on to discuss the zone system not only as applied to watering but to other things. In Paragraph 58 you say it is possible to limit or prevent the extension of coal dust explosion by dividing workings into sections separated by watered spaces on main roads. I see that it does refer to watering. You say "into sections" What sort of distance would you suggest that the sections should be from one another?—I have prepared a diagramatic plan explaining what I mean by sections, and what places in the pit should be so watered (*producing Plan**).

10639. (*Chairman.*) These are very damp sections, these damp places (*indicating*)?—Yes. The Plan is just diagramatic, but it assumes the main haulage roads from the pit *here* to the working face *there* are about 1,000 yards in length. Near the pit are the main junctions, presumably to another seam by a stone drift, by a self-acting incline to No. 1 District and by an engine plane to No. 3 District. At the point of intersection of all these roads thorough watering should be done extending at least 50 yards into each roadway. Following the main haulage roads along we come to another junction where another engine dip and self-acting plane comes to the main haulage level, at which point also watering should be done. Down this engine plane you have another intersection of districts and roadways, and at that junction watering also. Again, here at the main road going to the No. 1 face; here I have shown a longwall face of 1,000 yards, and I assume that that face is cut by machinery, and is extremely dusty, and that shot-firing is going on, and I suggest that in such a long face as that some isolation should also be carried out by watering a length of the face, and watering a corresponding length of the roadway adjoining the face, so as to cut that district into two sections. The roadways on that Plan between the watered spaces are about 500 yards.

10640. (*Mr. Enoch Edwards.*) Would about 4d. a ton cover what you suggest?—That would cost 4d. per ton.

10641. So that it is possible to do it for less than 4d. a ton?—Yes. The system shown on that plan, of course, would cost much less than 4d. a ton, but I have not estimated any cost.

10642. (*Mr. Smillie.*) In the worst mine under those conditions would it cost 4d. per ton?—The worst mine I referred to just now; that system should be carried out, and would not cost 4d. per ton.

10643. (*Sir Lindsay Wood.*) You propose to arch these zones all round?—That depends upon the conditions of the road. In some cases it would be necessary, and in some cases it would not.

10644. (*Dr. Haldane.*) You would be rather liable to have more crushing at the junctions of the roads than at other parts?—Yes.

10645. Arching might be more necessary?—Arching might be more necessary. At any rate where the watering is done the road must be specially prepared and made secure so as not to be injured by the watering any more than is avoidable.

10646. (*Mr. Enoch Edwards.*) If you were starting at a colliery now and you had a good seam to go on at, you would consider in putting down those watered zones there you would cut off the possibility of any explosion traversing beyond that point?—Of any explosion happening in any district extending to any other district.

10647. You would confine it to that particular area?—Yes.

10648. (*Chairman.*) You could not confine the after-damp?—No, but it would be limited, because the explosion is limited.

10649. (*Sir Lindsay Wood.*) What proportion would you have working in these longwall faces as compared with those on the wagon-ways or the other parts of the mine which would be cut off by the zones?—More men in the faces, of course, than on the roadways.

10650. Can you name a percentage?—I could not say.

10651. How many men would you have from here to here (*indicating*)?—That depends altogether upon the system of working, and also upon the haulage arrangements. Some haulage arrangements take few hands, and others take a number of hands.

10652. Would there be 10 to 1?—Probably, on this one road.

10653. There would be 10 men employed in that face for every one employed on this haulage place up to the zones?—10 men on that place to every man employed in that particular face in that particular pit on the Plan.

10654. Practically the watering on that system would not save a large number of deaths?—Yes, the watering by that system would prevent an explosion happening in that district extending to any other district. That is the point.

10655. (*Dr. Haldane.*) You are assuming an explosion at the face is not probable also?—Not as probable as an explosion in the main roadways. It is a coal dust explosion.

10656. (*Chairman.*) Still you have a wet zone. Where you have a longwall system with a very long wall you would have a wet zone all to itself, or close by on the working face?—Yes, under certain conditions when the face is of such a dusty character that it appears to be necessary.

10657. Would you make that system of zone watering compulsory upon all mine-owners in dry and dusty mines?—Yes.

10658. You would say they must water upon the zone system?—Yes.

10659-60. I suppose the Germans are not satisfied with the zone system, but insist upon watering all over the mine?—(*Dr. Haldane.*) They water everywhere in the dangerous seams.

10661. (*Chairman.*) Then, you say, you would have these roads specially prepared, if necessary, with brick-work, closely timbered and cemented, and the floors paved with bricks?—Yes, where necessary.

10662. That is to say you would make it compulsory that not only there should be these zones, but that the roadway should be made up in such a way that the watering should be carried out in the best possible way?—Yes, one naturally follows the other. If watering is insisted upon, you may depend upon the roads being properly prepared.

10663. The airways, you say, would not usually require to be so treated, or the travelling roads?—The airways are rarely traversed by explosions.

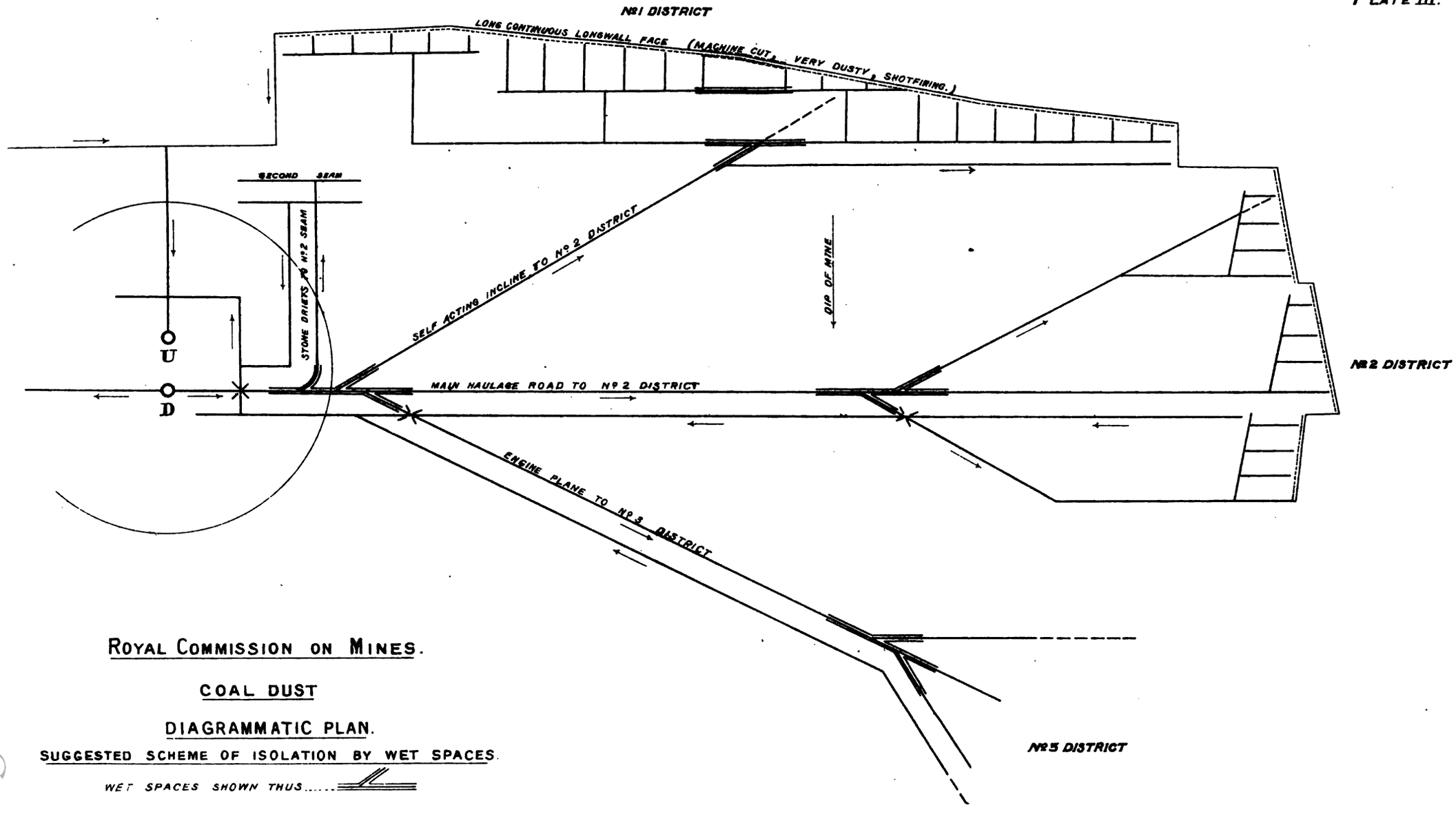
10664. Would you put it in the power of the mines inspector to make a report to the manager, and, if the manager objected, to have some means of compelling him to water upon the zone system airways and travelling roads? How would you deal with the case of airways and travelling roads? Do you think in some cases they ought to be watered, and that in some cases it would not be necessary?—Yes, I think generally it would not be necessary.

10665. Would you put it in the hands of the mines inspector to say on his own account whether it ought or ought not to be done, or give some sort of appeal?—I do not think it would be fair to the colliery manager or the inspector to put it in the inspector's hands entirely. The matter would have to be referred, like other matters, by the Coal Mines Regulation Act to arbitration in case of difference.

* *See* Plate III.

Digitized by Google

PLATE III.


No1 DISTRICT
LONG CONTINUOUS LONGWALL FACE (MACHINE CUT, VERY DUSTY & SHOTFIRING.)
SECOND SEAM
STONE DRIFTS TO No2 SEAM
SELF ACTING INCLINE TO No 2 DISTRICT
DIP OF MINE
U
D
MAIN HAULAGE ROAD TO No 2 DISTRICT
No2 DISTRICT
ENGINE PLANE TO No 3 DISTRICT
No3 DISTRICT

ROYAL COMMISSION ON MINES.

COAL DUST

DIAGRAMMATIC PLAN.

SUGGESTED SCHEME OF ISOLATION BY WET SPACES.

WET SPACES SHOWN THUS.....

APPROXIMATE SCALE OF FEET

0 500 1000 1500

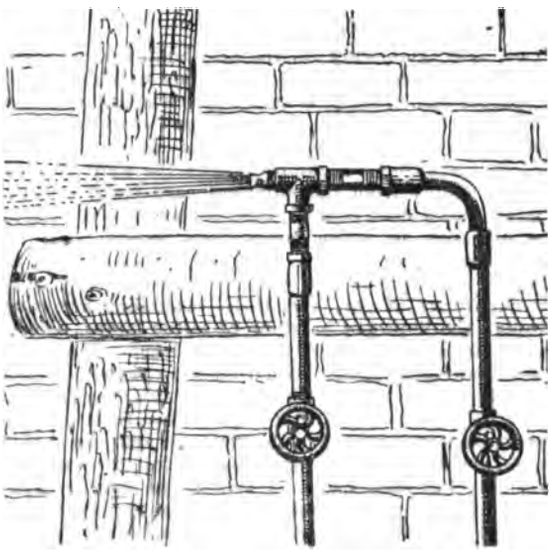
Digitized by Google

Digitized by Google

10666. You would have arbitration ?—I do not see any other plan.

10667. You would not leave it in the hands of the Secretary of State, for instance, to decide himself ?—No.

10668. Then you go to the method of watering roads. You say jets of water under pressure are not satisfactory, but that jets with compressed air are better ?—Yes. I have a sketch of a jet here (*Handed.*) That is the jet described in the summary.



10669. That, you think, is fairly efficient ?—Very efficient.

10670. But the workmen object to the discomfort ?—In this case they did, because more jets were used than were necessary. In another case they are working admirably and are quite effectual in properly rendering damp all surfaces of a roadway 100 yards long. There are three jets.

10671. The usual system that appears to be adopted, both in Germany and elsewhere, is hose-pipes ?—Yes.

10672. Do you think that is a better system ?—It is a very good system, quite as good as jets. I rather think that that is the most practicable of all systems.

10673. When you have this system of watering by hose-pipes, who are the persons who carry it into effect, who have charge of these hose-pipes—just the ordinary workmen ?—No, not the ordinary workmen. There are special men whose duties also combine looking after the traffic on the road.

10674. There is a special man who understands such things ?—Yes.

10675. I asked that because we had it from another witness that he thought, generally speaking, the most inefficient and cheapest men were employed at that work ?—I think it should be under the care of the roadman of the district. That is the man responsible for the carrying of the traffic through those roads. He is the most likely man.

10676. You considered that in cases where you have known this hose-pipe system of watering carried into operation, it is done effectually, and the men in charge of it are persons who understand their business ?—Yes, it should be carried out effectually.

10677. And generally is ?—Yes. It is more likely to be if you adopt the zone system than universal watering. One of the disadvantages of the universal watering is that if made compulsory on a very large scale it would be indifferently done, but if done upon a smaller or more practicable scale it will be properly done.

10678. It need not be indifferently done. That again is a question of cost ?—Yes.

10679. The tendency would be, if there was an immense amount of watering that had to be done, to get the cheapest form of labour to do it, whereas if there were only a small amount of watering to be done you would naturally employ more skilled labour. Then you talk about sprinkling with salt and having 30 cwt. of salt per 100 yards. Do you think that is a good thing ?—Yes, a very good thing. I have found it answers very satisfactorily.

10680. Does that do away with the necessity of this sprinkling by hose-pipes ?—No.

10681-2. It is only in addition to it ?—I do not suggest that it does away with it, but it is a very useful auxiliary, and is also useful in other roads where watering is not adopted. It is inexpensive and effectually prevents an accumulation of dry dust upon the surface of the road.

10683-4. Then with regard to the removal of dust, you have something to say about that ?—Yes, I have adopted the system of blowing away by a pipe of compressed air dust from the road and the surfaces of the road before watering, and the results are very satisfactory.

10685. Supposing you dislodged by means of compressed air the dust from the sides and the roof, and made it settle on the floor, then you would water the floor. You would have to have efficient watering ?—Yes.

10686. It might be that the use of compressed air might do away with the necessity of watering roof and sides ?—Yes.

10687. If thought undesirable to water the roof and sides you would get rid of the dust off the roof and sides by the compressed air, and get it on to the roadway ?—Possibly under certain circumstances that may be satisfactory, but generally I suggest it only as of use for the purpose of clearing the road of dust before watering is begun.

10688. Then the dust is carried to the workings beyond, you say. That is an objection, I suppose: the dust is not done away with altogether, but some of it is carried to the workings beyond ?—Yes, that is in cleaning by compressed air, and I tried to arrest that dust by a number of water jets, but that was not successful. Of course this would only have to be done upon a few occasions, when a roadway was being prepared for watering.

10689. Then you call attention, in Paragraphs 70 and 71, to what seems to be the great danger in explosions, and that is the danger from shot-firing, and you say that the Rules are too complex and confusing. We have had some evidence that the Rules, especially the Rule as to watering, are very often not complied with.—Yes.

10690. I suppose you take every care to see that the Rule as to watering is complied with in shot-firing ?—Yes.

10691. You think that it is complied with. Do you think you are able to get that Rule complied with ?—I think the Rule is not generally read in the same way. Some people do not consider that it is necessary to water the roadways if a permitted explosive is used.

10692. Surely there is no question about that. What is the Rule ?

(*Mr. Ratcliffe Ellis.*) It is in the Explosives Order. That depends upon the Explosives Order ?

(*Witness*) Yes.

10693. If only permitted explosives are used the Explosives Order describes where they shall be used ?—If a permitted explosive is used and the shot-firing takes place between shifts, or when not more than 10 men are in the pit, watering of the roadway is not necessary.

10694. (*Chairman.*) If 10 men are not in the pit ?—Yes, that is so. That is the Explosives Order.

10695. The Explosives Order is the one you go by ?—Yes, but there are so many Acts and Special Rules and Orders that the whole thing is very confusing, and should be made more clear by a better Code of Rules: especially may I say for the purposes of the underground officials and the ordinary workmen who have to carry out these Rules, who are to-day in a fog about them. They do not understand them.

10696. You have no doubt yourself that watering is necessary even in the case of permitted explosives if there are more than 10 men down in the pit ?—I would have the main roadways always watered whenever a shot is fired, when they are dry and dusty.

10697. 20 yards from the shot ?—Yes.

10698. Whether 10 men were down there or not ?—Yes: and further I would have no shot-firing in main roadways which are dry and dusty, in the ordinary shift. All such firing should be done between shifts. I regard shot-firing on main roads dry and dusty as the most dangerous operation in coal mining.

10699. That should be never done while men are underground, but always done between shifts ?—That is my opinion.

10700. With regard to watering, it has been suggested to us that the Rule as to watering for 20 yards is not sufficiently explicit, and that there ought to be definite Regulations laid down of the kind of watering necessary, and that it should be laid down that there should be a certain amount of pressure of pipe in order to ensure that the roof

Digitized by Google

Mr. A. M. Henshaw.

23 Jan. 1907.

and sides are perfectly watered?—I do not think you can go as far as that.

10701. Where is it laid down in the Explosives Order that you need not water if there are only 10 men down below?

(*Mr. Ratcliffe Ellis.*) I think it is at page 5 of the new Order that you will find the Section Mr. Henshaw is referring to.

(*Chairman.*) "In every coal mine the use of any explosive is prohibited in the main haulage roads and in the intakes unless all workmen have been removed from the seam in which the shot is to be fired, and from all seams communicating with the shaft on the same level, except the men engaged in firing the shot, and in addition such other persons not exceeding 10 in number as are necessarily employed in attending to the ventilating furnaces, steam boilers, engines, machinery, winding apparatus, signals, or horses, or in inspecting the mine: or unless a permitted explosive is used under the conditions prescribed in Section 2 of this Order, and every part of the roof, floor and sides of the main haulage road or intake, within a distance of 20 yards from the place where it is used, is, at the time of firing, thoroughly wet."

(*Witness.*) Yes.

(*Chairman.*) That makes it perfectly clear that watering is required if the workmen are not removed even though a permitted explosive is used. There is no exception to that I can see. Is there, Mr. Ellis?

(*Mr. Ratcliffe Ellis.*) I was under the impression that watering is not required if a permitted explosive is used.

10702. (*Chairman.*) You say in addition to that, you would have no case of shot-firing in the main roads while the men are down below, but you would have it always between the shifts?—In dry and dusty roads.

10703. So that you would strengthen the Order?—I would strengthen the Order to that extent, that in dry and dusty roads no shot-firing should take place except between shifts. That of course does not apply to the face, and applies only to dry and dusty roads.

10704. Then you make various suggestions in Paragraph 71?—I go on to say that I would limit the weight of the charge in all blasting underground. It has been proved by the experiments that have been made that the danger of igniting coal dust increases as the weight of the charge increases.

10705. It is only quite lately that this last new Explosives Order has been out? I do not know whether you have seen it?—Yes, I have.

10706. You say that the Manager or Under-Manager should give written permission for every shot in dry and dusty roads. What is the case now as regards shot-firing? Do workmen do it without permission?

(*Mr. Ratcliffe Ellis.*) No.

10707. (*Chairman.*) I do not know whether you mean to lay stress upon the word "written"?—I mean "written permission."

10708. Verbal instructions are in the habit of being given, but you want to have them in writing?—Yes, a written permission for every shot in a dry and dusty road.

10709. Where is the permission? Now the permission may be verbal?—Yes.

(*Mr. Ratcliffe Ellis.*) This is the Rule: "Every charge shall be fired by a competent person hereinafter called the shot-firer appointed in writing for this duty by the owner," &c. I do not know whether Mr. Henshaw means that an authority shall be given for the firing of every shot.

(*Chairman.*) Yes.

(*Mr. Ratcliffe Ellis.*) It says "by a competent person."

(*Chairman.*) I understand he means that authority must be given for every shot; that if you have to fire 20 shots simultaneously, you must have an order specifying every one of those 20 shots from the Manager or Under-Manager.

(*Witness.*) Yes, I go so far as that in a dry and dusty haulage road.

10710. (*Mr. Ratcliffe Ellis.*) You would have a competent person appointed to fire them?—Yes, that is a general authority, "by a competent person."

(*Mr. Ratcliffe Ellis.*) He must not fire unless he gets special authority in respect of each shot.

10711. (*Chairman.*) That is your view?—Yes, still applying of course to dry and dusty main roads. That is the cause of most of the serious explosions of coal dust that have happened—shot-firing in main dry and dusty roads.

10712. I do not know whether you are prepared to go into what is referred to in Paragraph 72, the question of safety lamps; we have had a good deal of evidence, but we are only now dealing by way of watering?—I mentioned safety lamps as incidentally a cause of explosions and indirectly the cause of coal dust explosions.

10713. Then you come to the question of coal dust tests in Paragraph 73.

(*Mr. Wm. Abraham.*) Do you not think, my Lord, since Mr. Henshaw has expressed his opinion so strongly that the proper care of lamps is one of the elements to decrease the danger of explosions, that perhaps the witness should give us some intimation of what he means? Does he hint that explosions occur because of the want of proper care or simply from not sufficient care being taken?—I mean that a good deal of stress is laid on coal dust, and the necessity to adopt precautions against coal dust explosions, and that we are likely to overlook the fact that most of the explosions of coal dust are indirectly caused by explosions of gas, and those explosions are caused through the improper handling of safety lamps, defective safety lamps or irregularities in shot-firing. That is why I say that safety lamps should be more rigorously tested than they are now, and that their construction should be more subject to rules and regulations than they are, particularly with regard to the diameter and length of the gauze, or better the cubic contents of the interior of the lamp, including the glass space. I believe the interior area of a lamp has a good deal to do with an explosion of gas passing through the gauze. We have no regulation of that sort, and I believe that lamps are being manufactured and put into the hands of underground people that are not safe in that respect. I also think—this is my own opinion—that no single gauze safety lamp should be allowed in any pit where safety lamps are required. A single gauze is quite safe in a proper condition, but when you consider the hundreds and thousands of safety lamps that go down the pit, I think that for safety the safety lamp gauze should be duplicated and that no lamp should be allowed underground without two gauzes.

10714. May I put one more question: are we to understand that what you mean is, that more care should be taken in the construction of the lamp itself?—Yes. There are so many lamps now on the market that I think the Government ought to make some test as to what is a good safety-lamp and what is not.

10715. Your remarks do not apply so much to the use of the lamp by the men?—No: my remarks refer to the construction of the safety-lamp.

10716. (*Chairman.*) I think it very possible that we shall take more evidence about safety-lamps by-and-bye, but at the present time we are upon watering?—During the past ten years there have been 49 explosions due to defects and the improper use of safety-lamps. There have been no less than 1,300 explosions caused by naked lights. All these explosions are, under certain conditions, likely to produce explosions of the coal dust; we are dealing with coal dust, but overlooking other causes of explosion which may result in coal dust explosions.

10717. For the moment we are dealing with the question of how far it should be compulsory to order mines to be watered. I daresay we shall deal more particularly with safety-lamps before we have finished. Now we come to coal dust tests. You say that the Courrières test was not satisfactory, because the gallery was only 30 metres long. You think that there ought to be longer and more elaborate tests. You urge strongly the establishment of a Government testing station to determine some standard of safety, and you say, to begin with a gallery 200 yards long, and add to as experiments suggest?—Yes: I have a very strong feeling in that matter that this coal dust question is of such importance that the Government certainly ought to take the matter in hand and investigate the whole subject upon a scientific basis, and upon a large and practical scale. I think it is necessary to convince everybody concerned in mining of the dangers of coal dust, and convince them in a substantial way, and particularly to bring the whole question before the notice of the large number of people working underground.

10718. We had a Royal Commission in 1894, but you think that it did not go sufficiently into the matter?—I think so. Mr. Hall's experiments were very good indeed, but they left a good deal undone

10719. If you have any more suggestions to make, will you make them to the Commissioners now?—Mr. Hall's

Digitized by Google

experiments were conducted with gunpowder. I have a very strong opinion that several of our permitted explosives are not safe in coal dust under certain conditions. The Favier powder, which was used at Courrières, is identical with some of our permitted explosives, and that by a blown-out shot caused the Courrières disaster. I think we should have further experiments made with coal dust and our permitted explosives. Mr. Hall only used a shaft 50 yards deep; when he went to a deeper shaft he failed to explode coal dust because the shaft was wet. He did get explosions in a deeper shaft, too, but my point is that experiments should be conducted in a horizontal gallery and under conditions almost identical with those which obtain underground, but carried out in the open atmosphere, where there is no possibility of firedamp. Mr. Hall's critics said that there was always a possibility of there being firedamp in the pit shafts. I do not agree with that myself, but I think it is quite necessary that something more should be done in the way of having a proper investigation and practical experiments upon the subject of coal dust. The expense need not be very great, and whatever the expense I think the subject is worth it.

10720. Have you anything else to say?—I do not know whether you want to go into the question of the analyses of the coal dust.

10721. Have you any papers dealing with that?—I am putting in a statement of the analyses of the Courrières coal dust and also coal dust taken from the Talk o' th Hill after the explosion.

10722. By all means put them in?—The figures are very interesting and I think of some importance, because they show in a number of places where dust was, that it was of such a non-inflammable character as to prevent the propagation of the flame, and the flame stopped at those places. There are a number of instances of that description.

10723. (*Sir Lindsay Wood.*) You referred to the explosion at Brancepeth. That was an exceptional one.—That was on the surface.

10724. It was in the hopper?—Yes, that is so.

10725. That is a circumstance you would not meet with underground?—Not likely to.

10726. You think that there is a good deal of difference between the endless rope haulage and the main rope haulage for creating dust?—Yes.

10727. Do you think it makes much difference?—A good deal of difference, because of the slow speed of endless rope haulage and the high speed of main and tail rope haulage, and the tubs rushing by at a high speed, and meeting the intake air, produce a cloud of dust which is raised from the top of the tubs.

10728. The tubs are longer on the road with the endless chain haulage?—Yes: but they are not subject to the same current of air.

10729. Not the same force of air?—No.

10730. In some cases it would be impossible to have endless rope haulage?—Yes, that is what I said, due to the character of the strata, the inclination of the seam, and the geological conditions generally.

10731-2. I did not quite understand why you recommended iron ends to the tubs. Would that make any difference?—Simply that tubs so constructed are more substantial and likely to be maintained in a dust-proof state of repair. I think it is a better construction than if built entirely of wood. In the tub I mentioned the bottom is steel and the two ends steel, and the sides only of boards. The ends are separate and the bottom is separate, and the boards in pieces as usual, and the whole tub is bolted together and not riveted. The fault of the ordinary steel tub is that it is generally riveted together, and when once damaged it has to be taken to the boiler shop and to be re-built.

10733. Tubs of that character of steel and wood would stop the spreading of dust considerably?—Yes.

10734. Mr. Galloway who gave evidence earlier to-day said that watering the floor of the roads in some cases stopped explosions of coal dust. I think he must have meant that it depended upon the force of the explosion?—Yes.

10735. The damper the place, the more likely. A very slight explosion might be stopped by watering on the road?—Yes.

10736. In an ordinary explosion it would not?—I think not. At any rate, the watering on the floor could not be relied upon. Under certain conditions it might arrest an explosion if the explosion was a very weak coal dust flame.

10737. Your suggested watering with compressed air would require two lines of pipes?—Yes.

10738. Do you just put a jet in a main roadway? You do not circulate it round the whole circumference of the place?—No, there is a connection to each pipe, one being of compressed air and the other of water. The two pipes are then brought together in the shape of a "T" with a pointed cone jet inside, and a current of compressed air blowing through the escaping water. The result of that is the water is perfectly diffused, and there are no droppings of water on the floor. It is really a water vapour, and blows from the end of the pipe like steam, and is carried many yards along the roadway.

10739. Does that sufficiently saturate the dust on the top of the beams?—Yes, it practically saturates the air. I have some figures of a test recently made. Three jets were placed in a roadway 100 yards long, and the jets were 25 yards apart. The hygrometer in the atmosphere before reaching the first jet showed a wet bulb of 69 deg. and a dry bulb of 72 deg. At a distance of 20 yards beyond the first jet the readings were 68½ deg. and 69¾ deg. At 40 yards 68¾ deg. and 69 deg., a difference of only a quarter of a degree there. At 60 yards there was complete saturation; both hygrometers read 68½ deg. At 100 yards, 69½ deg. and 70 deg., and the effect on the roadway is to completely damp the surfaces to prevent any accumulation of dry dust.

10740. That would occur on the roof and timber as well as on the floor?—Yes, the timber as well as on the floor.

10741. You gave the cost of watering in a particular mine of yours at 10d. per ton, which would come to a very large sum of money in the year. Have you had any dust explosions in such a mine?—Not in the mine I am referring to.

10742. Had you spent that amount of money it would not have done any good?—I selected one of the worst collieries; it is a colliery that is very faulty and very irregular in formation.

10743. It was only an estimate?—Yes, I gave an estimate which I think would apply to one of the worst collieries I know, to show how unfair compulsory watering would be if universal, and applied to such collieries as that.

10744. In a less degree it would apply to a good many others?—Yes, in a less degree it would.

10745. If you take the whole of the accidents which have occurred from coal dust or through the medium of coal dust, there are very few altogether in England?—Of accidents due to pure coal dust explosions.

10746. Accidents complicated by coal dust?—Yes.

10747. I think in the last 10 years there are only some 20 accidents complicated by coal dust?—Yes, but I have not taken that figure out.

10748. There is only a very small number per annum?—Yes.

(*Mr. Smillie.*) 20 deaths.

(*Sir Lindsay Wood.*) No.

(*The Witness.*) 20 cases.

(*Mr. Smillie.*) What is the number of deaths?

(*Sir Lindsay Wood.*) 455 in the 10 years.

(*Mr. Smillie.*) That is a large proportion.

10749. (*Sir Lindsay Wood.*) I understood you to say that a large proportion of explosions which are complicated by coal dust are occasioned on the main roads?—Yes.

10750. Not in the working faces?—No.

10751. I understood you to say if these conditions of shot-firing were carried out, such as watering of places where a shot is fired in the main way, and done between the shifts, and the weight of the charge regulated, and so on, that would be a means of preventing a large number of these explosions in the main roads?—Yes, that is my view. ✓

10752. That would be a means of stopping the explosions from coal dust?—That is so.

10753. That is irrespective of watering the whole mine?—That is why I say the watering of the whole system underground is unnecessary, and that other precautions can be taken less than those. ✓

10754. You are really dealing with the source of the explosion rather than preventing it?—Yes, that is what I mean.

Digitized by Google

Mr. A. M. Henshaw.

23 Jan. 1907.

10755. (*Mr. Wm. Abraham.*) I understood you to say that the real danger was generally in the face?—I think I said the real danger at the face was firedamp, and not coal dust.

10756. There is coal dust in the face?—Yes, but the coal dust at the face is not of that inflammable character which you find in the main haulage roads, and explosions very rarely traverse the faces to any extent.

10757. With regard to the use of coal-cutting machines, I think you say they are most productive of coal dust?—Yes.

10758. In what way?—By the cutting and grinding action of the tools of the machine.

10759. Is that not a very fine, small dust?—There is such a large production of dust by a coal-cutting machine that a small percentage of it is of that impalpable character which is likely to propagate the explosion, and although I say that watering is not universally necessary at the face, or that watering precautions are not generally necessary at the face, I say that it is possible to conceive a very long face cut by machinery which requires such a precaution to be adopted as I suggested, that is, dividing the face into two by watering a part of it.

10760. Is there any large amount of small allowed to remain in the goafs in the colliery that you have been dealing with here?—No, we do not stow the small coal in the goaf as you do in South Wales. It is generally sent out of the pit in the Midlands.

10761. Supposing you did, would that not increase the danger if you used explosives to bring coal down?—The stowing of coal dust in the goaf?

10762. Yes.—Yes, but still that coal dust is slack and coarse, and not I say of the character most generally dangerous.

10763. You have been speaking here of blasting coal in the face?—Yes.

10764. I understood you to say that that was the real danger?—I say that the real danger at the face is firedamp in blasting.

10765. Then there is a source of producing an amount of very fine coal dust by the coal-cutting machine?—Yes.

10766. That will stick to that face while the coal is up. Is not that so?—Yes.

10767. If you allow blasting there, is not the danger increased by using the coal-cutting machines?—I will not go further than I did when I said it is possible to conceive under such conditions that danger is introduced by coal-cutting machinery.

10768. Where the gas is emitting it will be emitting there?—Yes.

10769-70. There you have your three sources of danger, fine dust produced by coal-cutting machines which hangs on?—I say generally that the face regarded from the coal-dust point of view is not an unsafe part of the pit, but it is a question of degree, and a face cut by a machine will still, from the point of view of coal dust, be more dangerous than a face cut by hand. That is as far as I go.

10771. That is increased by the fact that gas is emitted there as well?—Of course that is a danger present in every face.

10772. (*Mr. Ratcliffe Ellis.*) Is that specially likely to happen where there is coal cutting?—It is not consequent upon the coal cutting.

10773. It is only the dust made by coal cutting?—Yes.

10774. (*Mr. Wm. Abraham.*) The witness said what increased the danger was the emission of gas?—No.

10775. Have you not said two or three times that the danger at the face was the emission of gas?—We are treating now of coal dust as a separate source of danger, and it is generally admitted that coal dust can be ignited by an explosion of fire-damp, but that coal dust cannot be ignited in itself, and I say that the face generally is not dangerous from a coal dust point of view.

10776. You have said also here to-day more than once that the real danger was gas after it?—I say again, speaking of the face, that coal dust is not the danger, but that fire-damp is the danger.

10777. Then you have your three elements of danger. You have the new danger created by the extra amount of dust produced by the coal-cutting machine, which is not produced by the men working by hand, and you also have the gas, and the shot. My question is this, and I think it is a fair one, is not the danger of coal hewing increased in that case by the use of cutting machines?—We are not disagreeing. I quite agree those conditions are the most dangerous conditions you can conceive at the face.

10778-9. Are you still of opinion that the roads then after all are the most dangerous part of the colliery?—Oh decidedly. Wherever coal is conveyed, the roads along which coal is conveyed are the dangerous parts of a colliery.

(*Sir Lindsay Wood.*) The most deadly.

(*Mr. Wm. Abraham.*) I suppose so.

(*Sir Lindsay Wood.*) There is a difference between the two. There is a large number of accidents occurring at the face, but they are not nearly so deadly as those in the main road.

10780. (*Mr. F. L. Davis.*) May I ask one question bearing upon what you have been saying. Mr. Abraham put it to you that a good deal of dust is made as you have already explained, by machinery?—Yes.

10781. This is what I want to put to you: the amount of the dangerous dust, that is the very finest dust made by these machines would be a very small percentage of the total dust made. Would that not be so?—That is what I have said several times.

(*Mr. F. L. Davis.*) A very small proportion of the dust made by the machine would be of that very fine sort that would be dangerous.

10782. (*Mr. Wm. Abraham.*) That would be the finest sort and most dangerous. You have a certain amount of the most dangerous dust created by that machine?—Yes.

10783. Would you make it compulsory in all dry and dusty seams to have dust-proof tubs in use?—No, I would not make it compulsory. I do not think that it is necessary.

10784. Do you think that it is advisable?—Yes.

(*Mr. Ratcliffe Ellis.*) Not to make it compulsory, but he thinks that it is advisable to adopt them.

10785. (*Mr. Wm. Abraham.*) You think naturally that there will be less danger in these roads if that kind of tub is adopted?—Yes.

10786-8. What is your opinion about the gobbing of small coal. In the goaf (we call it the gob) is that not a certain source of danger?—I think you know more about that, as it is practised in South Wales.

10789-96. It is the increasing of the elements of danger?—Yes. Generally speaking, I regard the stowing of coal or slack in the waste as an element of danger, of course, always likely to promote spontaneous combustion.

10797. (*Mr. Ratcliffe Ellis.*) You said that there is some dust which is not only not dangerous, but which would stop an explosion?—Yes.

10798. Is it possible to classify the mines in which that would apply?—No, I do not think it is. Our data are not good enough. We have very little to go upon, but I make that statement from the examinations which I have made of the dust at Courrières and Talk o' th Hill explosions, where I found certain dusts were incapable of starting combustion or propagating the flame.

10799. It would be very useful if it could be shown from which mines the dangerous and non-dangerous dusts came?—Yes.

10800. Do you think that that would be one of the things which might result from an inquiry such as you have suggested?—Yes.

10801. At Courrières, what evidence did you find that a particular kind of dust stopped the explosion?—The explosion was really stopped where dust contained 42·30 per cent of ash.

10802. Was that dust in its natural condition, or was it brought to that condition by some outside agency?—It was brought to that condition probably by the ordinary repairing of the road, and the falling of shale from roof and sides, ground with the coal dust underfoot.

10803. You have some specimens of it, I think?—Yes, there are some here (*producing specimens of dust in bottles*).

10804. I think Dr. Haldane will know more about that than I do.—*That* is dust that actually stopped the explosion. There are two dusts here. These two samples of dust were taken 70 yards apart. *That* actually carried the explosion, and the flame traversed the road up to this point, and then the evidence of flame ceased, and *this* is another sample of dust taken 70 yards away which showed that the explosion was actually stopped there.

10805. Did you get such further information as would enable you to form an opinion as to how that dust came into existence, and how that dust came into the situation?

Digitized by Google

—Yes, very clear evidence indeed. Up to this point coal was being drawn along the roads, and colliers were at work. Rails were laid exactly up to that point. Beyond that point there were no rails laid. The road was simply an airway, and 20 yards beyond the dust was of quite a different character. *That* is coal dust practically; *that* is shale dust; *that* carried the explosion; *that* stopped it.

10806. Where did this dust come from—the explosive dust?—That dust probably came from the carrying of coal along the roads.

10807. (*Mr. E. L. Davis.*) You say up to *this* point, then the rails stopped. They branched off in one direction? —Yes, *there* (*indicating*). There are several instances of that sort, and other samples yet. *That* is the floor of the heading in which the explosion commenced by a blown-out shot; *that* is a sample of dust from a heading in the same seam not far away where the explosion actually stopped. *That* (explosive dust) is pure coal dust containing only about 8 per cent. of ash. *This*, again, was from the haulage road, but a haulage road that had been recently repaired, and there was a good deal of shale lying about, trodden underfoot, and that stopped the explosion.

10808. (*Mr. Ratcliffe Ellis.*) Have you, in your experience, found a similar state of things in mines in this country, found dust which would carry on an explosion in the same mine and dust which would stop it?—Yes, I have a similar set of figures and analyses of 18 samples of dust taken from the Talk o' th Hill Colliery after the explosion there. The explosion was stopped by dust containing ash 44·73 per cent., and in one case possibly by dust which only contained 39 per cent. of ash.

10809. There is no doubt that the explosion in each of these cases stopped because there was nothing to feed it so to speak?—Yes.

10810. (*Dr. Haldane.*) Have you any figures showing the relative coarseness of these dusts?—No. All the samples were sieved through a safety lamp gauze having 784 meshes to the square inch, and I regard dust of that fineness, if pure enough, inflammable or explosive; they are dusts screened through the safety-lamp gauze. They have not been further ground.

10811. They seem to vary in fineness?—That is due to the smoothness of the shale and the gritty character of the coal dust.

10812. Supposing you had a dust with a mixture of coarse parts and fine, what effect do you think that would have upon an explosion?—I think a mixture up to the size of the mesh of a safety-lamp gauze would be explosive, or the particles up to that size would be capable of distillation into the gases in the coal.

10813. Usually at the working face you get a lot of coarse coal mixture?—That would have a cooling and suffocating effect; a quenching effect it must have. That is, a cloud of fine dust like that would be more inflammable than the same analysis of dust if mixed with many larger particles—if that is what you mean.

10814. Yes.—Yes, I agree.

10815. (*Mr. Ratcliffe Ellis.*) Did you find at Courrières any condition of things which either was likely to bring about an explosion or to make it more serious than prevails generally in mines in this country?—That is a very wide question. There is a great difference between the underground conditions and method of working, and so on, of the Courrières Colliery and an ordinary English colliery. The differences are so defined that I do not think you could argue quite from what you find at Courrières and apply those arguments to an ordinary English colliery.

10816. You cannot compare them?—No.

10817. Did you notice any sources of danger at Courrières that are absent from our collieries in this country?—Not sources of danger connected with the explosion.

10818. Any conditions likely to contribute to an explosion and to increase it or to make it more serious?—The one condition, the extensive area of the underground workings, which does not obtain in an English colliery. That is one thing. There it was estimated that the roadways laid with rails in the four pits affected by the explosion amounted to 110,000 metres of rails.

10819. That state of things you considered was less safe than the more limited area of openings in this country?—Yes.

10820. Is there anything else that occurred to you there.—Yes, probably the practice there of connecting extensive workings in an extensive way. I mean very large workings joined up to each other indiscriminately in a way that is not practised in this country.

10821. Is there anything else?—No, I do not think of anything else. Do you suggest anything else?

10822. Not at the moment. Do you think that those two conditions were answerable for the explosion either in its inception, so to speak, or in its consequences?—Yes, in consequences, certainly.

10823. As to the origin of it?—It had nothing to do with the origin of it.

10824. You think that those two conditions made it far more serious?—Yes.

10825. Those are absent from the mines in this country? —Yes, to some extent.

10826. Did I understand you to suggest that you would make it compulsory, either by Rule or by Act of Parliament, that dust-proof tubs should be used?—No.

10827. You would not make it compulsory, but you would leave that to the Managers?—Yes.

(*Mr. Wm. Abraham.*) He thought it would be advisable.

10828. (*Mr. Ratcliffe Ellis.*) I want to see if he would make it a Rule. You think that it is advisable that some kind of tub should be used which would not get rid of the dust, which would not deposit it on the roads as it went along?—Yes; in many cases if the tubs in use were kept in a proper state of repair the evil would be minimised.

10829. You are familiar with the German practices?—Yes.

10830. In Germany I believe it is the law that in all mines water pipes must be provided and maintained in working condition so that all parts of the mine used for coal-getting, haulage, passage of men, or ventilation, can be watered for the prevention of danger from coal dust in accordance with the Regulations contained in Paragraphs 34 and 35. That requires all mines of every sort or kind to be watered. Then there is a provision for exempting certain mines from this general obligation. Would you approve of such a system being established in this country? —No. My evidence is against it. I disapprove of it, and I think that so far as I have gone, that is suggesting watered spaces, if that becomes law there should be, of course, the same exemption clause.

10831. I was going to ask you about partial watering in my next question. You suggested that it should be compulsory to water certain zones or spaces?—Yes.

10832. In such cases you would permit exemptions to be made where the watering would be injurious?—Yes, I think you must, of course.

10833. It would apply only to dry and dusty mines?—Yes.

10834. Even your watering?—My watering would only apply to dry and dusty mines.

10835. What proportion of the dry and dusty mines, I do not know if you can answer this question, would require an exemption from a variety of circumstances, where watering under the conditions in that mine would be injurious?—Not many. I should think not more than 5 per cent.

10836. You think not more than that? You think in 95 per cent. of the dry and dusty mines that the watering to the extent that you suggest could be done without any other damage arising from it?—To the extent I suggest I think so.

10837. (*Dr. Haldane.*) Is that assuming the roads were arched, if necessary, or without arching the roads?—Prepared in some way, either by arching or special timbering.

10838. (*Mr. Ratcliffe Ellis.*) Would you be disposed, instead of making the watering compulsory, to say that in these particular zones that either the dust should be removed, or, if that is not practicable, that its danger should be mitigated by watering?—I do not think it is possible to remove the dust.

10839. There are views of some mining engineers that to remove the dust is the proper remedy?—They are not generally held.

10840. At any rate, you do not agree?—I do not agree.

10841. You do not agree that it is possible to remove it? Your view is that nothing except watering can be done to prevent the danger from this dust?—Yes. Even if a length of roadway of 100 yards were arched with brickwork and kept clean I do not think it could be kept

Digitized by Google

Mr. A. M. Henshaw.

23 Jan. 1907.

sufficiently free from dust so as to stop the propagation of a dust flame; it can only be done by watering, only by keeping the surfaces of that arching in a damp condition.

10842. Do you think that there is no difficulty in getting round the props and the bars at the corner and tops of the road in watering? Can you water every corner?—Yes, you can.

10843. Do you think that there would be any advantage if steel props were used instead of wooden ones?—Yes, it would be an advantage.

10844. Would that be more expensive?—Yes, and it is advisable where you set out a length of road for the purpose of watering that the road should be specially timbered, or even done with steel girders, or the sides and roof cemented.

10845. That is, the zones you would water should be specially prepared for it, so that watering might be effective?—Yes.

10846. In your view that would go a long way to prevent the spread of an explosion?—Yes, I think it would.

10846A. (*Mr. Enoch Edwards.*) Your attention was called to the filling of tubs and over-filling them. I understood you to suggest that there was not much risk or danger from tubs being filled above the top, because it is usually large coal?—Yes.

10847. Does it not follow in the ordinary way of working that a lot of this coal falls off in the roadways?—I think not. Generally when the tub is finished and loaded above the top of the coal the pieces are built in. They are blocks of coal that are built in. The top of the tub is not finished with a shovel, but it is built in with large pieces.

10848. Ordinarily where tubs are filled above the top, does not a lot of coal get knocked off?—Some of it does, no doubt.

10849. The whole place looks slatternly and slovenly?—Yes.

10850. Largely, I suppose, the places have been made more dusty in consequence of this slovenly method of filling and chucking the stuff about everywhere?—Yes.

10851. The question was put to Professor Galloway that after all it is not possible to remove the dust in such a way that an explosion would not be carried?—I think that it is so difficult and so uncertain that after trial most people would resort to watering. I think that the result of a trial to render a length of road free from dust would be so disappointing, I mean the appearance of the road afterwards, that they would come to the same conclusion that I have, that it must be kept wet.

10852. You have suggested in your evidence that there are places?—I am more inclined to make my answer to that question strong because of the trial I have made of clearing a road with a jet of compressed air. You can remove, as with a hose-pipe, by holding a jet of compressed air, a large volume of dust, and apparently render a length of road free from dust, but you may go back and go over that same length of road again and again and again, and each time raise a tremendous cloud of dust, so that I came to the conclusion that you must go further than that and render the dust damp—what dust there is.

10853. I am speaking now about the main haulage roads?—Yes, the main haulage roads.

10854. It occurred to me, with regard to your suggestion about the cost, you could clear it all with a few men in the road. After all much of the fault of these explosions in dust in travelling roads has arisen through the loose coals where the roads have been left and where there has been no attention paid to the roads?—That is true.

10855. Then if you watered zones that would not relieve you of that obligation of cleaning this road somewhat?—Quite so.

10856. You think that it is not possible to clean all this dust away to render it safe?—I am quite sure that it is not.

10857. At the same time do you suggest that there are mines where it would not be wise to adopt compulsory watering?—Yes.

10858. And conditions of road in which it would not be wise?—Yes. I should reserve the power to exempt certain collieries or certain parts of collieries.

10859. In dealing with this question of shot-firing for the moment, Mr. Abraham put it to you that the danger at the face was not dust, but firedamp. An explosion at the face either would arise because of blasting or an imperfect lamp?—Yes.

10860-3. To get an explosion at the face you must have firedamp?—Yes.

10864. Have you given much thought to what abolishing blasting altogether in coals would mean?—Yes.

10865. Do you think that it is possible?—No, I do not think that it is possible to abolish blasting altogether. There are some seams of coal which really could not be worked under present commercial conditions.

10866. While you are blasting you always have a considerable amount of risk?—Yes. I say blasting is the greatest source of danger in mining, and that is why I say there is still room for improvement in our permitted explosives, and room for improvement in the testing of permitted explosives and the passing of them.

10867. Are there any permitted explosives in use at all, or any of them, that give off flame at times?—I think they all give off flame. I have seen a flame from several of them.

10868. What was the nature of the material that they were using at the Courrières mine when you were there?—Favier Powder No. 1.

10869. Was that supposed to emit flame?—Yes. It was not in France regarded as one of the safe explosives, but at the same time the analysis of Favier powder is almost identical with certain explosives on our own permitted list which are regarded as safe.

10870. Do you suggest that the Government should have these explosives submitted to a severe test?—Yes. I do.

10871. That is while blasting is necessary we should, if possible, get an explosive, if we can, which will not emit flame?—Yes.

10872. Do you think that the Government ought to take steps to ascertain how far it is possible to secure one?—I think that more might be done at the Experimental Gallery at Woolwich than is done.

10873. (*Mr. F. K. Davis.*) I want to thoroughly understand whether I am right or not. What you recommend is watering in zones?—Yes.

10874. Not the thorough watering of all the roads in the mine?—That is so.

10875. For the reason, I believe, that the conditions are so different in different seams and different districts that it would not be fair to lay down any General Rule?—That is quite right.

10876. The reasons I think you mentioned in Paragraph 8 are the disturbance of the strata?—Yes.

10877. The squeeze, and I put in addition to that—I do not know whether you have mentioned it—the cost of timbering would be in some seams much greater than it is at present?—Yes.

10878. I think you say (I do not know which pargraph it is) that probably thorough watering in certain districts would increase the accidents from falls of roof and sides?—Yes.

10879. With regard to the coal dust that goes down the shaft, you say there you do not think very much of that. It is not a very serious matter. Is not that so?—I do not quite go so far as that. It is a serious matter where dust is carried down the shafts, but at the majority of the collieries in this country I think that danger does not exist, because so many of the shafts are wet.

10880. That is what I wanted to get at?—And the effect of natural moisture in the shaft is to saturate the air to such an extent that the dust is taken up and deposited in the sump or close pit bottom, and is not carried into the pit workings.

10881. That is our experience in Wales, and all our screens are close to the shaft, but nearly all, or practically all, our shafts are wet?—That is the case in the majority of the collieries in this country.

10882. You just now replied to Mr. Edwards that you did not think coal-mining could be carried out without shot-firing?—Yes.

10883. Do you consider that if shot-firing is carried out in strict accordance with the present conditions that are laid down, that that would prevent a very large number of explosions?—Yes, it would.

10884. I put it to you in this way, that if all the conditions or possibly some further conditions with regard to shot-firing in addition to what exist now—if they existed and were carried out strictly—there would be so many less explosions, and we should have very much less trouble with the coal dust?—That is what I am saying.

Digitized by Google

10885. There is no necessity to go in for a new kind of tub with springs, such as was suggested by Professor Galloway, to prevent the shaking and the making of dust in travelling ?—No.

10886. Have you had any experience yourself of distances that are arched in the manner you suggest ?—Do you mean arched distances kept wet ?

10887. Yes ?—No.

10888. Or experience of certain distances, say 100 yards, kept wet, but not arched ?—Yes.

10889. Have you much squeeze in your district ?—Yes.

10890. If you were to arch certain distances you would still have the difficulty of the squeeze disturbing your arches. You would still have to repair and keep on repairing your arches ?—Yes, whether you were wet or not.

10891. Once your arch is there practically the wetting of that arch would not make much difference to the squeeze, but the natural squeeze of the strata must go on ?—Yes.

10892. (*Mr. Smillie.*) When you say the natural squeeze must go on, will you tell the Commissioners exactly what you mean by that. Do you mean for all time ? Does not the squeeze go on for a certain period and then settle absolutely ? I will come to a case in point. 100 yards from the pit bottom you put in a strong arch and you get 1,000 yards beyond that point a longwall working. Does not there come a time when the working settles and there is no squeeze in the arch 100 yards from the pit bottom ?—It certainly follows to some extent, and if not again disturbed by the working of any other seam above or below might not give much trouble afterwards.

10893. I suppose we may take it that there are arches 20, 30, 40 or 50 yards long in workings which are not being squeezed just now ?—Yes.

10894. Is it not generally the case that when the longwall face gets away two or three hundred yards from the certain point in the road, that that squeeze by that time is almost finished ?—It is very variable. It depends entirely upon the character of the strata. Sometimes in strong strata with a big percentage of rock the settlement is more rapid, but in other strata where there is a small percentage of rock the disturbance goes on for a long time.

10895. If you work other seams above, the disturbance may come on again ?—Yes.

10896. Have you had much experience of coal-cutting machinery ?—Yes.

10897. In thin seams or thick seams ?—Not very thin.

10898. Where there is a small vein of stone or shale the cutting is usually done in that ?—Yes, for there would not be much dust produced.

10899. That is exactly the point. Do you know whether it is the case that in the majority of cases where coal-cutting machinery is working at the present time they are cutting in a small vein of stone at the bottom of the seam ?—No, I would not go so far as to say in the majority of cases, but in a number of cases they are.

10900. In any case in under-cutting by coal-cutting machinery the under-cut is considerably thinner than the cut made by workmen working with picks ?—Yes.

10901. If cutting in stone and not in coal, there would be considerably less dust raised than there would be by coal cutting ?—Yes, considerably less.

10902. The coal in general cases comes down in larger blocks. There is less small coal (what is called "dross") produced by coal-cutting machinery ?—Yes, that is so.

10903. You say that the horse-roads are not often dangerously dusty ?—They are not.

10904. I suppose you would not, on that ground, advocate horse haulage exclusively ?—No.

10905. To the exclusion of other classes of haulage ?—Certainly not.

10906. That arises from the floor being cut up by the horses' feet ?—Yes.

10907. You say the velocity of the air-current is not usually so great there ?—That is right.

10908. You pointed out, in reply to a question by Mr. Edwards, that where tubs were loaded above the top of the tub itself it was usually with large pieces of coal which were well set, and that they did not usually fall off ?—Yes.

10909. Paragraph 51 of your *précis* says loaders at face should be strictly enjoined not to put fine coal on the top of tubs. Loaders do not put small coals on the top of the tubs where the coal is raised above the sides of the tub ?—Sometimes, and they fill the middle with small coal with a shovel. I say they should be enjoined not to do that, because that is the dust that blows off by the air-current. I was not referring to coal that fell off the tub, but that which was blown off by the air-current.

10910. Would I be right in saying the class of coal in this country which gives off the largest quantity of explosive dust, or dust which would be dangerous in an explosion, gives a very large percentage of small coal ?—Yes.

10911. In some cases there are no round coals which can be built up in some cases where that class of coal is produced ?—In a few cases there may be, but it would hardly pay to work such a seam.

10912. Do you know any cases where the height of the roads makes it impossible to put any coal on the top of the tub, and those are roughly filled with a shovel ?—Yes.

10913. And that small coal in that case inevitably finds its way to the top as well as the round coal ?—Yes.

10914. Did I understand you correctly in saying that 90 per cent. of the workings of the mines in this country are broken workings ?—No, I do not think that was my answer.

10915. Paragraph 55 is—watering of ordinarily made roads would disturb strata and timbering and increase danger from falls. I understood you to say in your answer to Mr. Ellis, I think it was, that about 90 per cent. of the workings in this country were in broken strata.

(*Mr. Ratcliffe Ellis.*) No, he said in 95 per cent. of the mines the watering could be done without any injury to the roof and sides.

(*Witness.*) Not without any injury. There would be some injury in most cases, but in five per cent. you would have to exempt altogether.

10916. (*Mr. Ratcliffe Ellis.*) That watering could be applied in 95 without any serious damage ?—So far as there may be any watering at all.

10917. (*Mr. Smillie.*) The most serious statement made by the witness was that in a typical mine, in one mine at least which he had in his mind, if saturating with water took place it would cost annually 10s. per yard to repair ?—Extra.

10918. In addition to the cost of the watering ?—Yes. That would be an extra cost in regard to the watering.

10919. The additional cost for repair would be 10s. per yard ?

(*Mr. Ratcliffe Ellis.*) That is in addition to what it would cost if he did not water.

(*Mr. Smillie.*) In the first place it was the cost, I take it, without any watering at all, to keep the roads in repair. If you saturated the roads with water it would cost so much per ton to do that ?

(*Mr. Ratcliffe Ellis.*) It would cost 10d. per ton more.

10920. (*Mr. Smillie.*) It costs at any time under normal conditions so much to keep up the road generally, but if you saturate those roads it would cost so much per ton to do that ?—

(*Witness.*) Yes.

10921. In addition to that it would cost 10s. per yard to keep those roads in repair ?—Extra cost, due to watering.

(*Chairman.*) It does not include the daily cost of watering ?

(*Mr. Smillie.*) That was in addition.

(*Witness.*) That is an addition altogether.

10922. (*Chairman.*) Also the interest on the capital sum you expend to produce the system of watering ?—For the installation.

10923. (*Mr. Smillie.*) May we take it now that that state would apply only to 5 per cent. of the mines in this country, that 5 per cent. of the mines would be in such a state ?—I could not make a statement as to that.

10924. You know at least one ?—Yes.

10925. That is only an estimate ?—Shall I give you another estimate ? I know another colliery where, if universal watering were compulsory, the colliery would have to stop altogether—the cost would be so great that it could not possibly go on.

Digitized by Google

Mr. A. M. Henshaw.

23 Jan. 1907.

10926. Has it been tried?—No, but I know the colliery sufficiently well to give that answer.

10927-31. You believe that to be the case?—I do. I am speaking from pretty close and long experience.

10932. You say that zones of 100 yards, say, in every 1,000, would be quite effective in your opinion?—Yes.

10933. That a watered zone of 100 yards for every 1,000 yards of working in the main road would be quite effective? —Yes.

10934. Could we reduce that to a cost per ton? If in an ordinary mine it would cost for additional upkeep of the roads 5d. a ton for saturating the roads with water, or rather, for repairing them afterwards, if you only do that in zones of 100 yards in the 1,000, would that come to ½d. per ton for extra cost?—I must ask you not to commit me to figures of that sort now. I gave you the 5d. this afternoon as an estimate made upon the spur of the moment. If you want to take me further and try to say that because it takes 5d. per ton on the average colliery for universal watering that it would take one-fifth of that———

10935. One-tenth?—If only one-tenth of the watering had to be done, I must rather protest against being led into such an admission.

10936. I would like to tell you my reason, and I am sure you will sympathise with me. We are particularly anxious to have some system of watering the roadways to prevent serious explosions?—So am I. That is why I am here.

10937. There may be opposition to it upon the ground of cost, and the Commission I feel sure will be extremely anxious to prove that it will not be so costly as to make it impossible to do it, and I take it from your figures if it cost in the worst case 10d. per ton for repairing the road as the result of universal watering, and 5d. as the average, that if we did not do watering universally, but watered zones of 100 yards in the 1,000 that perhaps the cost of upkeep might be reduced to ½d. per ton, and so it would not be so serious a matter?—I think it is more likely to be perhaps 1d. per ton.

10938. That is really my reason for asking you?—I see, and I should be very glad to give you such a figure if I felt I could, but I do not think I can. The ground is a bit too wide.

10939. (*Mr. Haldane.*) You are speaking chiefly, I suppose, of North Staffordshire?—I think I had better answer Yes. I was trying to carry my mind a little further than North Staffordshire, but I think I had better say Yes to that question.

10940. (*Mr. Smillie.*) Are there in North Staffordshire mines with the same nature of roof and sides similar to the mine you quoted as to the 10d. per ton?—Yes.

10941. In which the strata are naturally wet?—Yes.

10942. And they shut them up because they cannot work them?—Yes, I think I say in my proof that I know of certain seams of coal which were naturally wet, and after a trial were abandoned because of the disability———

10943. They could not keep them open because of the damp condition of them?—Yes.

10944. Could you say that from your knowledge or from statistics which you have gone into. You state here that the universal watering would lead to a large addition to the accidents from falls?—Yes.

10945. Have you any proof in your own experience or the experience of the Mines Inspectors that the number of accidents from falls of roof and sides is greater in seams which are naturally wet than in dry seams?—I have no such figures.

10946. It is not your experience you say that the number of accidents will be greater?—It is from general experience I know, and any practical man knows that it is more difficult and precarious to timber and keep safe a wet seam than a dry seam, and a wet roof than a dry roof.

10947. Is the percentage of accidents greater in a wet seam than a dry one?—I should answer without hesitation, yes.

10948. In answer to Mr. Ellis, you said, in dealing with the Courrières explosion, that one reason for the difference between Courrières and any mine in this country was that the explosion at the Courrières caused such a large number of deaths. If an accident took place at a mine in this country under similar conditions where 1,200 men were employed, and two pits——

(*Mr. Ratcliffe Ellis.*) I understood him to say not the extent of the disaster, but the extent of the workings, that the wide area of workings contributed to the extent of the disaster.

10949. (*Mr. Smillie.*) May I take it that an explosion of a similar nature might take place in this country and cause as many deaths as were caused there?—The conditions of mining in this country are so different that I cannot answer that question. It is quite conceivable that in some of the largest collieries in this country where workings are very extensive and the output very considerable, and the number of men employed exceeding as they do in some cases 1,000 in the pit at one time, that an explosion, where no precautions are taken against coal dust, might be extremely disastrous, but I cannot go further than that in trying to draw a comparison between Courrières and an English colliery.

10950. Do you know any mine in this country at the present time which is said to be dry and dusty in which 1,000 men are employed, and in which the whole mine is ventilated from one ventilating current?—I think you are questioning me too closely. I do not think that is quite an admissible question, is it?

10951. I gathered from your reply to Mr. Ellis that you thought an accident of a similar nature, or of so extensive a nature, could not take place in this country—but if you say you do not mean that I am quite satisfied. If you did mean that, then I put, I think, a perfectly fair question to you now?—I said in reply to Mr. Ellis that the conditions were so different that such an accident is not so likely to happen in England as in France. I say to you now that the conditions of mining in this country are such that we have collieries dry and dusty, at any rate in parts, where over 1,000 men are employed, and an explosion in such a colliery would be very disastrous. I do not think you ought to press me to go further than that.

(*Mr. Smillie.*) That is quite sufficient for my purpose. The reason I put that was that our miners are of opinion that such a thing could take place here.

10952. (*Dr. Haldane.*) Take the case of the Albion Colliery. Supposing the explosion of 1893 had occurred in the day-shift, there were over 1,000 men employed in that, and nearly every man was actually killed in the explosion in the night-shift?—It is quite possible the deaths would have been 1,000.

10953. Supposing it had happened in the day-shift?—Yes.

10954. (*Chairman.*) Do you suggest that it is not so likely to happen here as in France because there is not so much underground communication here, or so many ramifications of underground communication, or do you suggest that we in England are more careful with miners' lives, and take greater precautions with regard to coal dust in mines than abroad?—My answer is, because it is not the practice in this country to join up underground so many separate pits, and our underground workings are not so extensive as in France.

10955. Would you be inclined to consider that legislation might be desirable to prevent any very considerable intercommunication between underground workings. Do you think that?—I do not think there is any necessity for such legislation in this country. The danger is already appreciated.

10956. And sufficiently?—I think so.

(*Mr. Smillie.*) I am afraid his answer is not satisfactory. He says because we do not link up; but my point is that we have workings in this country with one air-course in which there are more than 1,000 men employed, and if such an explosion of the same nature takes place it would kill 1,000 men. They are linked up in the same way.

(*Chairman.*) Mr. Henshaw thinks that the managers are sufficiently awake to the danger of too great underground intercommunication, but you think they are not sufficiently alive to it. May I put it in that way?

(*Mr. Smillie.*) We have mines in Wales at the present time sufficiently close to link up four or six as was done at Courrières, and in the event of an explosion taking place, 2,000 or 3,000 men might be killed. But there are mines in this country of a similar nature to Courrières in which 1,000 would be killed.

10957. (*Dr. Haldane.*) There are more precautions taken in this country than in France as regards the day-shift. I mean as regards blasting, and so on, during shifts?—I think so.

10958. There is that difference?—I think so.

10959. You suggested that experiments should be carried out on a larger scale than at present as to the

Digitized by Google

influence of dust in colliery explosions, and you suggested having a long gallery for these experiments ?—Yes.

10960. That would be a fairly expensive matter, would it not ?—Yes.

10961. Have you considered the question of expense at all ?—Yes.

10962. To make a gallery strong enough to resist pressure ?—I think some money from the Coal Tax which is still in hand might be applied.

10963. That is a practical suggestion. We shall be glad to put it on again ?—It would make an excellent use for it.

10964-5. You have only gone roughly into the question of cost ?—Such a gallery might cost £4,000 or £5,000. I cannot conceive any more wise expenditure than expenditure upon such a subject.

10966. I agree, and I have always thought that there should be something done. Are you clear that a gallery made above ground is better than attempting to use any existing underground abandoned mine ?—Yes, I do, and a gallery that can be open to observation properly constructed of re-enforced concrete with the inner surfaces made of rough stone cemented together, so as to produce the condition of a gallery undergound——

10967. It is difficult to make a gallery sufficiently strong to resist the pressure ?—I do not think so. I think it can be done.

10968. Surely there are no data on that question. One knows a gas explosion taking place in a large gas-pipe will blow up the pipe underground, and there is a big pressure there. You might have the same thing in a gallery ?—There are already experimental galleries. There is one at Woolwich, and there is another at Frameries in Belgium, and another in Westphalia, which they constructed of re-enforced concrete, and they have been subject to severe tests, and I think it is quite practicable to construct a gallery that shall withstand any test that is necessary.

10969-70. They have flaps which open when the pressure gets up, but that is not quite a natural condition, is it ?—No.

10971. The question of where that gallery should be is another one. I suppose some central position in England would be the best ?—I should say so.

10972. You suggest a plan of watering in zones or segments. That would still involve the expense of carrying water-pipes right up to near the face, would it not?—It would be the best plan to do so.

10973. Did you contemplate doing it by any other means than pipes ?—I think it is quite possible to do it in other ways, by having a tank of water. If the position is so far removed from the pit that the carrying of a pipe is impracticable, a tank of water at the point regularly filled by other tanks coming in from the pit would answer the purpose. The water could be used from that tank.

10974. It is probable, is it not, that a good deal of watering would be needed to keep any such section of the mine constantly wet ?—No, I think not, if the place is thoroughly prepared and once in a very damp condition, it will take very little water. I think once watering every day will be sufficient.

10975. These sections which you propose are mostly in main intake roads with the air very dry ?—A large volume of air passing.

10976. Fairly dry air ?—Yes.

10977. I should have thought you would find the water would evaporate very quickly. Is there any practical experience to throw light upon that question ?—I have carried out this plan in two roads I mentioned in my proof, 100 yards long, and once a day was quite sufficient there. The volume of air passing would be about 8,000 ft. per minute.

10978. That is not very much ?—No.

10979. Were these on main haulage roads ?—Yes.

10980. But not main intake roads ?—And main intake roads. These were roads to isolate one district. The amount of air passing into that district was 8,000 ft. I am trying now brine instead of water where it is a long way from the pit, and there is a difficulty in carrying pipes to the point. I think the surfaces will become coated with salt and the hygroscopic property of the salt will render watering less frequent.

10981. I wanted to ask you about the salt. Do you imagine that the action of the salt is to act as a sort of cement for the dust, or is it to keep it moist ?—To keep it moist.

10982. Chloride of sodium is not a very hygroscopic substance itself ?—No.

10983. There is always chloride of magnesium in it ?—Yes.

10984. Would you rather not use calcium chloride or magnesium chloride ?—That is more expensive.

10985. It goes much further ?—Yes. If I had been called as a witness a little later on I could have given you some figures upon that. I have some at the colliery stores, but they are not yet used. Later on I may have results.

10986. Perhaps we can get that information from you later on ?—I will furnish it if possible.

10987. It is quite possible that the brine might act by making the coal dust stick together ?—It is quite possible that it does, but I have not noticed that. It is quite remarkable the effect of salt upon the surface of the road.

10988. Going into this question, we should very much like practical experience of the method you have suggested, or anything which will enable us to judge as to how it acts ?—Yes.

10989. I should have rather thought myself it would be apt to dry up very rapidly and require a great deal of constant watering ?—The surfaces of the road.

10990. On main intake roads, because the air is so dry. You are clearly of opinion that an official test of some sort for lamps ought to be instituted ?—Yes, I have a very strong opinion upon that point.

10991. Would you say that each type of lamp ought to be tested officially ?—I do.

10992. Before it is allowed to be put on the market ?—Yes, before it is adopted.

10993. You would lay down no strict regulations. You would allow to designers a large liberty ?—Yes. First of all we want to determine whether the lamps already in use are, under certain conditions, safe, and new lamps should be tested before being allowed to be sold.

10994. Do you think these tests ought to be made at a place such as Woolwich, or would you rather have them made, say, in each district ?—I do not think it matters where the tests are made so long as they are made by the proper authorities.

10995. Under the direction of properly-skilled persons ?—Yes.

10996. (*Mr. F. L. Davis.*) By the Home Office, I suppose ?—Under the authority of the Government and by specially-appointed men who are capable of conducting those tests properly.

Digitized by Google

SEVENTEENTH DAY.

Thursday, 24th January, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
WM. ABRAHAM, Esq., M.P. (Rhondda).
F. L. DAVIS, Esq.
ENOCH EDWARDS, Esq., M.P.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. GEORGE FOWLER called and examined.

Mr. George Fowler.
24 Jan. 1907.

10997. (*Chairman.*) I understand you are by profession a mining engineer?—That is so.

10998. You are agent to the Babbington Coal Company, Nottingham?—Yes.

10999. You are also, I understand, a colliery proprietor?—I am interested in two large collieries in Warwickshire, of which I am practically the managing director, so far as the mining operations go.

11000. With regard to the notes of your evidence on coal dust, I propose that these notes should be printed in the evidence preceding your examination, so that we may refer to them without necessarily quoting them.—Yes.

The Witness handed in a statement as follows:—

NOTES ON COAL DUST.

(1) It would probably simplify the consideration of the best way of dealing with coal dust in collieries if one or two remarks are made on the sources from which it proceeds.

(2) There is, first of all, the dust which is made by the getting of the coal in the working places; this is practically wholly carbonaceous dust, but it is carried by the ventilation into the return air-ways of the collieries. For the amount so made some figures will be provided by the experience of an old colliery at Cinder Hill, Nottinghamshire.

(3) The next sources of dust are from coals falling through and under sides of tubs. In some parts of the country the coal wagons are made of open framework, which allows small coal to fall through with great ease. In other parts of the country the pit wagons have close sides and bottoms, but are made with open ends with a view of assisting the loading, and it is from the open end that coal falls on the roadways. A tub made with close sides and ends of either wood or iron will very much lessen this cause of dust-making.

(4) The next source of dust is from the screens and sorting arrangements at the top of the shaft. These produce very frequently a large quantity of dust, and it is very probable that when they are close to the pit top, and strong winds prevail, a large amount of dust gets carried by the air and the ventilation down the shaft and into the roadways. Probably the most explosive dust of a colliery is the dust settling on the sides and roof of return airways, because, as before remarked, it consists nearly wholly of carbonaceous matter. It is, however, very rare that explosives are used in the air-ways, as these roads are somewhat smaller than the working roads. The working roads of collieries where the coal is got by long-wall are practically wholly made in shales and rocks. The dust in them is produced:—

(1) By the wear of the feet of men and horses on the floor or of cutting tools making repair to the roof or sides.

(2) By the disintegration of the air and the drying up of occasional water or damp.

(3) By the dust falling from passing coal tubs.

(5) It would, therefore, seem to be of the first importance to prevent the formation of dust, and it is submitted that the close-bodied wood or iron tub is the most likely to lessen the risk arising from this source. The witness has fitted a colliery wholly with iron-bodied wagons. These were probably the best from the dust-making point of view, but from the experience of working these wagons did not prove satisfactory. They were very subject to rust; they presented dangerous angles and points if they were damaged in work, and they were considerably heavier than wooden wagons. They were finally withdrawn, as in practice they did not work so well as those made of wood. It is submitted that if the boards are well seasoned the leakage of dust through the sides of the pit tubs is practically unimportant.

(6) Touching the question of preventing the accumulation of dust in working roadways, it is submitted that the amount of dust from either carbonaceous matter or earthy matter would be much lessened if the roadways—the main roadways—were paved or pitched with brick. The cost of this is comparatively small; two or three shillings per running yard of the roadway would generally cover the cost of this, and a roadway so paved presents many advantages in the practical work of the mine. It is less likely to heave or move in work; it provides a better foundation for the rails and sleepers; and altogether tends to make a better road. If, therefore, the making of a dustless road is a prime consideration, it would be well to start in most cases with a pitched roadway.

(7) Dealing with the sides of roadways, if these are of hard rock which can be swept and cleaned, and are fairly regular and smooth, all that they can require is a little dressing and trimming. If the roadways are of weak material, and require timbering or packing, it is easy to smooth the packs when they have been built either continuously, or between props, with a cheap mortar and so bring them up to a fairly clean and smooth surface.

(8) If the roofs of the roadways are supported by steel, and the witness is in his own experience referring to five or six large pits practically using nothing else, the flanges of the steel girders can be made close with roof boarding or slabbing between web and web, which very much strengthens and stiffens the girders, and presents a smooth surface for cleansing, and keeps air and moisture from coming in contact with the roof rocks. This also tends greatly to the permanence and stability of the road.

(9) It is submitted that roadways thus made present the best conditions for the economical working of a colliery, for when once well made they are likely to stand for some time without requiring further repairs. No doubt the conditions of different mines vary considerably, but in mines worked on the long-wall system, the main roads back from the faces are very generally settled down and are subject to very small movements of either side or top pressure.

(10) Having thus provided a roadway with a fairly continuous paved flooring which is easily swept at

Digitized by Google

intervals and kept clean, with sides which are fairly smooth and even, and with tops or roofs which can be largely kept smooth and even, it is submitted that, either over their extreme length or any long sections designed to break up the continuity of more dusty portions, mechanical sweeping may be used to prevent the accumulation of dust, and to bring the amount down to so small a quantity that it will be practically inexplosive.

(11) The witness would further desire to call the attention of the Commission to the use of the whitewashing machine. A small pump throws a mixture of whitewash on the surface of the walls, making them smooth and even, and lessening the chance of dust accumulating. This operation is also inexpensive.

(12) An application has also been made of a machine worked on principle of the vacuum cleaner, which is now so largely used in moving dust from domestic interiors.

(13) It is submitted that in the principal roadways of a mine, with a view of the accumulation of dust, not only is the cost of the operation less than that involved in the watering of the sides and tops, but that this plan is less expensive and is more efficient.

(14) Dealing with the question of watering, it is submitted, firstly, that the watering of roads must be more or less intermittent, and that when a road is watered and allowed to dry again, it is likely to become more dusty than before, as the act of watering tends to desiccate the materials of the sides and roof of the road. Secondly, it is submitted that a method of watering can very imperfectly reach dust on the tops of bars in the roof or of wood slabbing which is used to keep up loose dirt, and in cracks and crevices. Thirdly, it is submitted that the perpetual watering of the sides and tops of roads will in many cases bring on heavy weights and falls, and will substantially weaken the materials through which the roadways are formed.

(15) It is further submitted that the method of watering tends to rot timber and rust steel girders, and thus tends to shorten the life of the material with which the roadways have to be supported.

(16) It is further submitted that in mines where the temperature is high, the roadways would be, sooner or later, seed beds of ankylostomiasis. The deep mines of England have, up to the present, in the opinion of the witness, been free from this disease owing to their dryness. It is believed by him that, if the deep mines should by legislative agency be compulsorily watered, the health and life of miners would be seriously endangered thereby. It would, indeed, be highly probable that the remedy would be worse than the disease.

(17) The witness will be pleased to show to the Commissioners some sections of roadway at Cinder Hill Colliery, in Nottinghamshire, which were dealt with in this manner in the year 1896, and will thus be a very fair test of the permanence of this mode of treatment.

(18) He is also preparing a section of roadway in one of the seams of coal worked by Messrs. Morris & Shaw, at the Birch Coppice Colliery, near Tamworth, which will be open for their examination, and he will be provided with figures showing the cost of the application.

(19) In cleaning up the sides and roof of a section of a main road 20 yards in length at Cinder Hill Colliery, 20 lbs. of dust were collected. This represents 12 months' deposit.

11001. I understand you are the author of a paper which was read before the Chesterfield and Midland Counties Institution of Engineers, the title of which is "How a Mine may be Dry and not Dusty," and that paper was followed by a discussion, an account of which I have before me?—That paper was read in the year 1896.

11002. Yes, more than 10 years ago. May I take it that the views which you expressed in that pamphlet are pretty much the views which you hold to-day?—Yes, quite so.

11003. In dealing with coal dust in collieries you begin with the dust in the working places?—Yes.

11004. I understand that those who are in favour of watering mines do not as a rule consider it desirable that there should be watering on the face itself, or at all events not to any considerable quantity?—I have not heard any suggestion beyond the suggestion that has been made that a certain quantity of water should be put in each pit wagon; but so far as regards watering the face itself I have not heard a suggestion of that character made.

11005. It is done in Germany; Dr. Haldane went, in company with two Inspectors of Mines, to Germany to investigate the watering question, and he has furnished a Report to the Commissioners in which he says that he is hardly prepared to say that we should go so far as the Germans do in that respect?—So far as my experience goes there is dust at the face, but it is very small pieces of coal and not exactly the dust of the kind that we have back in the roads.

11006. It is not so fine?—It is not so fine; it is much coarser and rougher.

11007. You deal in your notes with dust from coal falling through and under the sides of the tubs?—Yes.

11008. Then you say that the next source of dust is from the screens and sorting arrangements at the top of the shaft. You go on to say that the most explosive dust at collieries is dust which settles on the sides and roof of return airways, because it consists nearly wholly of carbonaceous matter; but, on the other hand, you say it is very rare that explosives are used in the airways, as these roads are somewhat smaller than the working roads?—Yes.

11009. Then you go on to state how the dust is produced in the working roads of collieries, and the first suggestion which you make is that the wagons should be made more or less dust proof. But you do not propose, apparently, that there should be iron-bodied wagons; you propose that the wooden wagons should be improved by being made of well-seasoned timber, and you think that if that is done, and if the joints are close together and there is no leakage, that is the best form of wagon?—So far as my experience has gone in relation to wagons I may state this fact as bearing on the matter; at this particular colliery which I am referring to now, years ago a wooden wagon was used with an open end, and when the wagons were used with open ends coal in transit from the working faces to the pit bottom was so frequently shaken off, that the roads were extremely dusty, and there was a great deal of coal dust on the floor and blown on the sides of the roads. I saw that this was a cause of the accumulation of dust, and therefore I had the ends of the wagons closed up and made them into square boxes. The effect of making that change was to prevent the accumulation of a great amount of dust and to lead to a very small amount of dust being made in the mine. That is why I hold the opinion that the great cause of dust in mines is the imperfect means of conveyance so frequently used in bringing the coal from the working places to the pit bottom. I believe if a box wagon were used, made either of wood or iron, very little dust would be found to result. I believe that an iron plate at the bottom of a wooden wagon is possibly the best form. I know of some collieries which do use a sheet of iron at the bottom of the wagon, but I do not myself think that you can in practice have anything much better than a box made of ordinary seasoned boards and fairly well put together. I did fit out one of my collieries in Warwickshire some years ago entirely with iron wagons; they weighed about three-quarters of a hundredweight more, but they suffered so much from corrosion, either because there might be a little salt in the coal or because of coming to the bank to be emptied, that they very soon shook themselves more or less to pieces, and we took them out and substituted the wooden wagons which are used at present. Further to test the matter in the particular colliery in Nottinghamshire, which is more particularly the subject of the paper, I made about 8 or 10 years ago a batch of 20 wagons with iron bodies and 20 wagons with steel bodies, and put those into use: they weighed about three-quarters of a hundredweight more per wagon, and after working quite a small number of years they rusted through and were thrown on the scrap-heap. I put that to a test because I wanted to see how the iron wagon worked out in practice. It cost a little more—that is not a very material point—but it weighed more, and it was so much subject to rust in the thin sheet which we had to use of either iron or steel, that after quite a small number of years they had to come out and to go on to the scrap-heap. That is why I think that the iron wagon is not, in practice, very much better, and that under ordinary circumstances it does not answer as well as the close wagon made of fairly well-seasoned boards.

11010. Then you object very strongly to these open ends as being great scatterers of dust. Do you suggest that the ends should be fixed or that they should be let down, at all events, for the first portion of a filling. I do not know how that might be, or whether it would be possible to have a wagon with an end which could be let down in order to allow the men to more easily fill the wagon, and then, when the wagon is partially filled, to have the end firmly secured, and then continue the filling

Digitized by Google

Mr. George Fowler.

24 Jan. 1907.

until the wagon is full? I mean, is it necessary to have a wagon in which the end is absolutely fixed, or would it be possible to have a wagon in which you had the end like a flap to be let down so that you could fasten it up when required?—I have seen wagons in which the end is made to hinge and work like a door, but I think, in practice, that is not a desirable or necessary thing to have. I have two cases where we have a rather higher pit tub in use in a thin seam, and the wagon is made with one end not quite so high as the rest—some 8 or 9 ins. lower than the other end. Supposing the wagon is about 3 ft. 3 ins. in the total height, one end of it would be so much lower, so that a man could lift coal over that. I have noticed other collieries in which the same arrangement is made. At one end of the tub it will be a little lower, but practically the thing is a box tub, and that I think meets the difficulty of getting large coal over a high-sided wagon. I think if one end of the wagon is made a few inches lower than the rest of the wagon the difficulty of loading is overcome in that manner, and I think the effect of not scattering dust is gained.

11011. But might you not have a fixed end a few inches lower than the other end of the wagon, as you say and have a hinged flap so that when the coal is put in you can close up the wagon and make all four sides equally high?—Yes, I think you could.

11012. I should have thought there might be some advantage in that, inasmuch as if you have one side of the wagon, the loading side, rather lower than the other, it would lead to some extent to the scattering of the dust?—Yes, I think it does. I think what you suggest might be done.

11013. You speak of dust from screens and working arrangements at the top of the shaft. With regard to that, it has been suggested to us that, at all events, in new collieries, you should not have any screens within a certain distance of the pit, so that the dust would not go down the shaft—within, say, 100 yards?—Yes. As a matter of fact, at the collieries I have to do with, in nearly all cases, the screening arrangement, where most of the dust is made, is some distance away from the pit mouth. As a matter of fact in the Midland Counties collieries now, nearly universally, the coal is tipped on to a travelling belt of probably 100 yards in length, and it is tipped on near the pit top and the coal travels along that belt and gets at the end of the belt to something like 80 or 100 yards away from the shaft. That is the case virtually at all my collieries—that the great dust producing part of the business is remote from the pit.

11014. Do you think that there might be a General Rule formed applicable to all coal mines, put in as some amendment of the Mines Regulation Act, to the effect that screening of coal should not go on in new collieries, at all events within 100 yards of the pit mouth?—I do; I think that would be a very wise regulation.

11015. It has also been suggested that where there is screening going on near the mouth of the pit, it might be well to take some means of preventing dust from getting into the shaft at all; that would be by spraying or by watering in some way where the shaft itself is not sufficiently wet. It has been suggested to us that, supposing the shaft happens to be a dry shaft, you might have some system of spraying which would make the dust precipitate?—The dust from what?

11016. The dust from the screens?—But if they are 100 yards away, I do not see the need.

11017. No, but in collieries in which they are now not 100 yards away, or anything like 100 yards away, it has been suggested that it would be a good thing if there was some system of spraying the shaft, so that when dust gets down the shaft it precipitates at the bottom in a damp form?—I cannot say that I have considered that, but it sounds to me to be worth consideration. I should say that that would be a good thing. May I show you some samples of dust which have been collected from various parts of the mine? Would they be of interest to you?

11018. By all means. We will not deal with them now, but will wait until Dr. Haldane is here. You say that it would be desirable with a view to preventing the accumulation of dust in working roadways that the main roadways should be paved or pitched with brick; the cost of that you say would be comparatively small, and that 2s. or 3s. per running yard of roadway would generally cover the cost?—Yes.

11019. You think that a roadway so paved presents many advantages in the practical working of the mine, and you say what the advantages are. Then do you suggest that in all cases the main roadways of a mine should be bricked?—I do not think I have gone quite as far as that. There is, I think, some difference of opinion on the point as to whether it is desirable to make the whole of the main roads of a mine dustless, or only parts of them. I think a conclusion has not yet been arrived at on that point. The suggestions, so far as I venture to make them up to the present, deal with the question of making certain sections of a mine practically incapable of holding dust.

11020. Then you say that, having paved a portion of the main roadway with brick, if that portion be kept carefully free from dust, not necessarily by watering, but if it be kept free from dust by any means, that would prevent an explosion travelling?—Yes, that is the idea which I have.

11021. You think that would equally prevent an explosion travelling as it is considered the watered zone would prevent it travelling?—Yes, that is the idea.

11022. So that you would have those bricked roadways 100 yards in length?—Yes.

11023. And then after that it would be merely a matter of convenience as to whether you would brick the rest of the roadway or not?—That is so. What occurred to me further was this; assuming that the direction of policy generally in mining matters is to make the main roads of a mine less and less capable of transmitting an explosion, I think the first line to take is to pave. My suggestion to-day points in the direction of paving 200 yards, but I would go as far as to say that if it is desirable to take very strong steps to prevent the formation of dust, let us begin, if possible, to pave with brick the whole of the established main roadways of a mine, because it is a very inexpensive thing to do if you are dealing with large sums, as in fact in watering no doubt one would. The cost of paving with brick is not a very expensive matter in dealing with a few thousand yards of road; and I should like as a mining engineer in charge of a mine to say that I would sooner pave and sweep my roads than adopt a method of watering, as has been suggested by other gentlemen who have given evidence before you. That is how I wish to put it.

11024. The roof and sides, you say, must be dealt with besides the floor; and you say that that could be done by smoothing them, and they could be kept swept clean, fairly regular and smooth; and if you had a fairly clean and smooth surface, then you would be able to get rid of the dust?—Yes.

11025. How would it do to have a paved floor, and in cases where it was very difficult to make the roof and the sides, particularly the roof perhaps, even and smooth, to have a jet of air used so as to bring down the dust and deposit it on the brick floor, and then deal with it there—sweep it up from there, we will say?—I see no objection to that. I have a suggestion to make a little later, dealing with the question of clearing sides by a blast of air; but I gather that you are taking up this suggestion of mine with regard to the brick paving, and you mean that if you have a fairly smooth surface like a brick surface, and you can get the dust which is on the sides and top of the roads upon that, you may then sweep it up and slightly water it perhaps as a matter of convenience, as you like; but if you get it on the ground you then can sweep it up. My earliest recollection of mining goes back to about 50 years ago when I was articled with the late Mr. John Thomas Woodhouse, a mining engineer of very large experience, now deceased, at the Moira Collieries, in Leicestershire. There the roads were paved with brick, and one or two old men at night used to sweep those roads clear of the dust and horse droppings, and the roads were cleared in that manner, and very clean and excellent roads they were. That was an experience of 50 years ago. The Moira Collieries are very large collieries and working very successfully at the present time.

11025A. (*Mr. F. L. Davis.*) Were they large at that time?—Yes.

11026. What was the output at that time?—I think it was some 300,000 or 400,000 tons a year. They were very large collieries; they were sunk in the year 1810 or 1815; they were managed in the first instance by Mr. Woodhouse's father, and when I was articled to him he was the manager. He had a very large connection as a mining engineer in Leicestershire, Derbyshire, and Nottinghamshire. The Moira Collieries were under his special management, and he was living quite close to them. I was articled to him at that place, and that is my earliest recollection of the main roads which were paved with brick and swept by old men, and I remember what

Digitized by Google

Digitized by Google

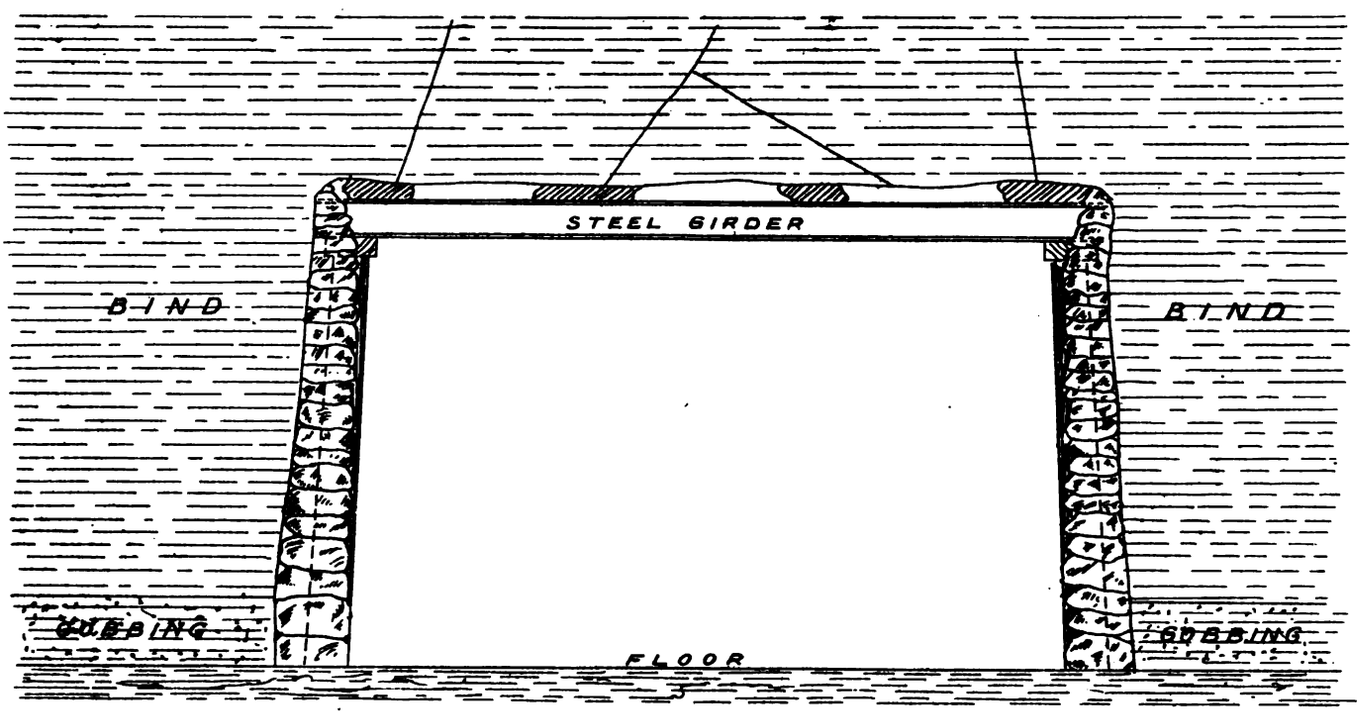
ROYAL COMMISSION ON MINES

BABBINGTON COAL CO.

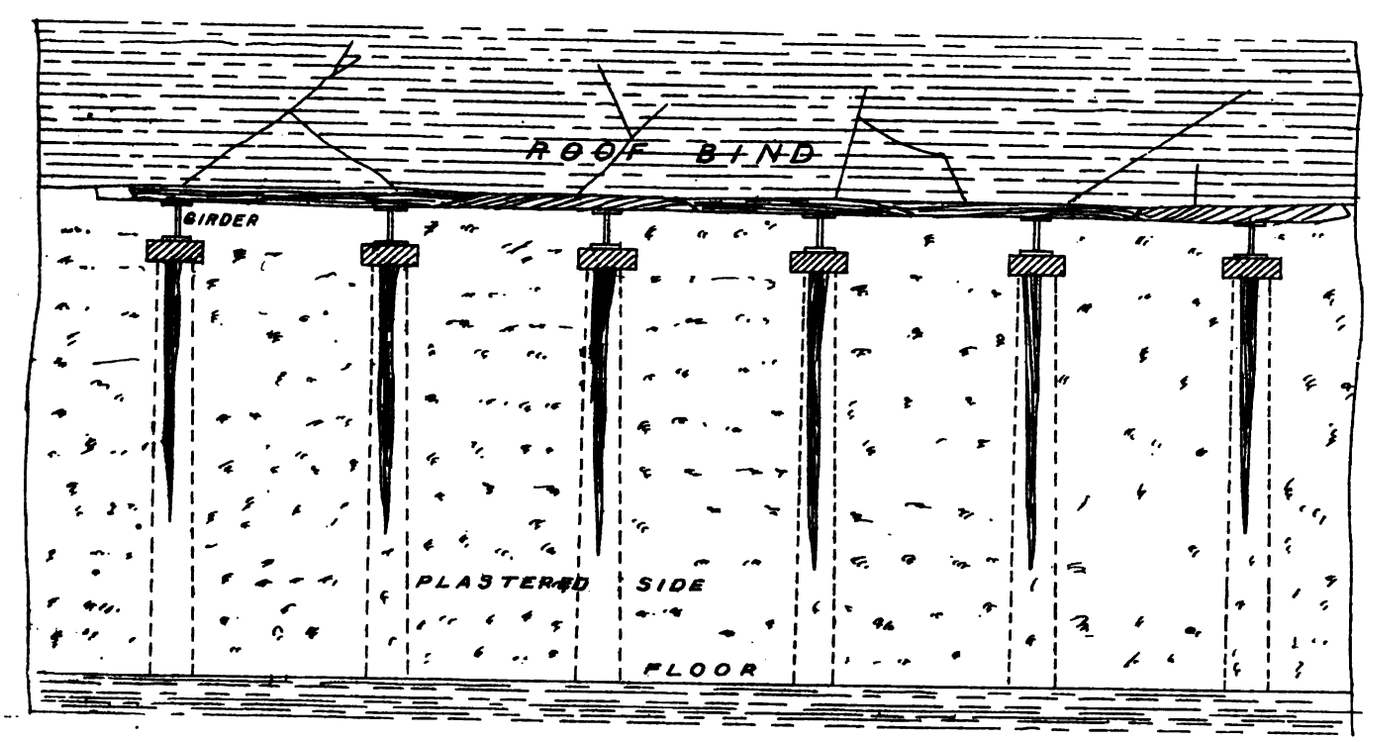
CINDER HILL PIT.

DIAGRAMS SHEWING ROADS WITH PLASTERED SIDES.

SCALE 3/8" = 1 FOOT



CROSS SECTION.



LONGITUDINAL SECTION.

Digitized by Google

Weller & Graham, Ltd Litho. London.

Digitized by Google

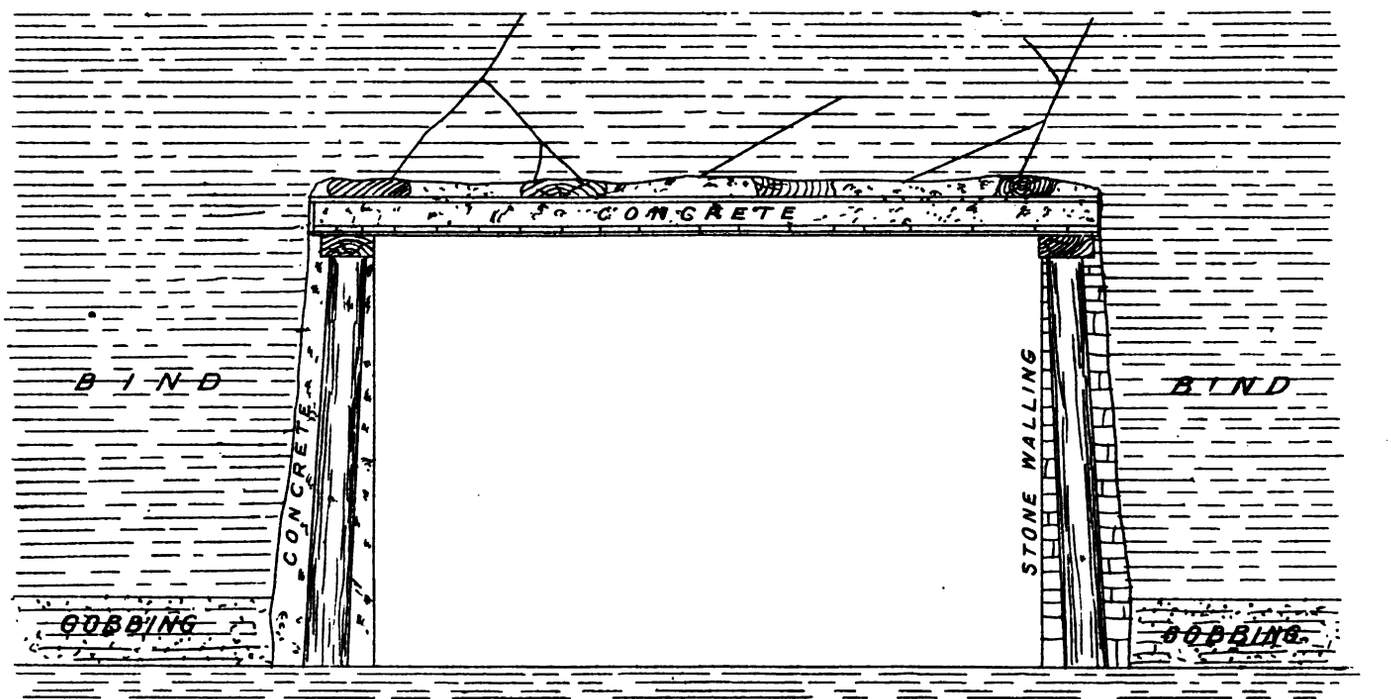
ROYAL COMMISSION ON MINES.

BABBINGTON COAL CO.

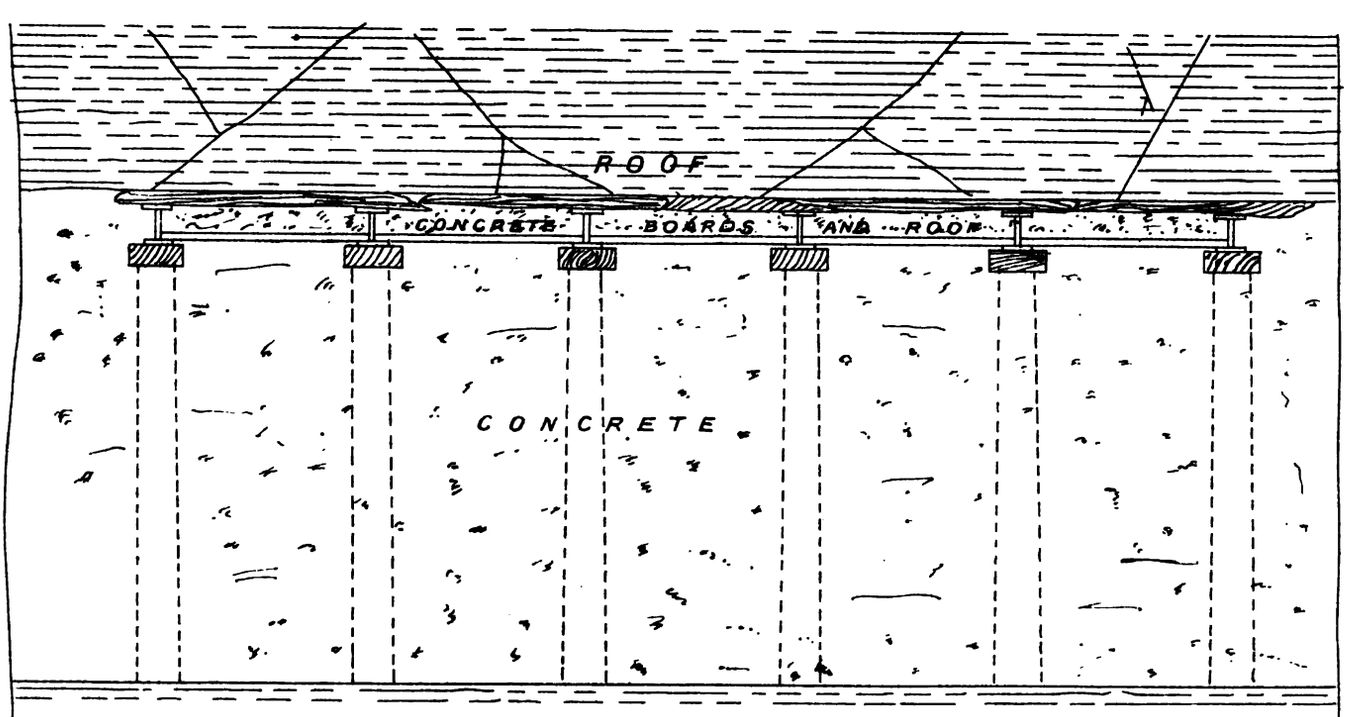
CINDER HILL PIT.

DIAGRAM SHEWING ROAD WITH CONCRETE ROOF AND SIDES.

SCALE 3/8 = 1 FOOT.



CROSS SECTION



TRANSVERSE SECTION.

Digitized by Google

601.
Weller & Graham. Ltd. Litho. London.

excellent roads they were, and how dustless and clean they were.

11027. (*Chairman.*) Without the use of any water?—There might be a little water used.

11028. I suppose you must sprinkle dust with water or it would rise in a cloud. If you swept the very fine coal dust from a brick floor it would rise in a cloud if you used no water, would it not?—Sometimes they would use a water-barrel, possibly. But at that time horses were used very freely, and the horse droppings always made a certain amount of moisture; as a matter of fact the dust that was made was easily dealt with in that manner. Coming to present times, when horses are not used so much, and when you have this dust underground, I think a man with a water-barrel would be able practically to supply enough moisture to get the dust into a tub in a conveniently workable manner, so as to clean up.

11029. You would suggest sweeping it into a tub?—Yes, into a tub.

11030. Then what do you do with those tubs?—Send them out from the pit on to the bank, in the same way as the waste rubbish is sent, of which, I am sorry to say, we have to send out often more than we like.

11031. (*Mr. Ratcliffe Ellis.*) With reference to the Moira Colliery, that is in existence still?—Yes, it belongs to the Moira Colliery Company.

11032. Is the same practice pursued still?—I could not tell you.

11033. Is it a dry and dusty mine?—I think so.

11034. What is the record of the colliery so far as regards accidents?—It is extremely free from accidents; it is a very well managed colliery. I know the managing director, but I do not now have anything to do with the mine. The late Lord Donnington, who owned those collieries some 20 years ago, called me in once to advise him; he had let them get into a very bad condition. I saw that what was wrong was that some money wanted spending, and my advice to Lord Donnington was, "Let your present manager"—who is now the managing director—"have a free hand, and he will put them right." Circumstances happened, and Lord Donnington died, and a certain company took the matter in hand. I believe now those collieries are very well conducted collieries; but as to what they do now with reference to paving and so forth I have no knowledge; it is quite 30 years since I have been down them.

11035. (*Mr. Wm. Abraham.*) How often do you sweep these roads? Is it done every night, or are portions done every night?—Portions are done every night; one or two men would practically keep the roads in a colliery clean in different sections of the mine.

11036. So that if you had any breakage of coal on the road that would be filled up every day—coal falling from a tram?—Yes.

11037. So that there would not be much dust from coal to be dealt with each day?—That is so.

11038. Its being done regularly would lessen the work and make it easy?—That is so; taking for instance, the Nottinghamshire colliery, which I base chiefly my opinions upon; on the main roads there we sweep with brooms and besoms once a year the props and roof and all the main roads. But the sections which I particularly desire to keep clean, and which are more or less bricked, are swept two or three times a year. The cleaning of the roads for breakages by tubs being upset and that sort of thing, which you mention, is done very frequently and very regularly; we make it a point to keep our pit very clean.

11039. (*Chairman.*) With regard to the roof and sides, would you say that it is better to do it with brooms, or that a jet of air would be a better method?—I think a jet of air would be the better means; but I have got brooms and I have not at present got the jet of air.

11040. What length of roadway in a very dry and dusty mine do you suppose could be attended to and kept fairly clean by one man?—I have a note here with regard to the isolation zones as we have shown them on the plan which is before you. In the Cinder Hill pit at Babbington the sweeping and cleaning of dust off sides and cleaning it up on the roads costs 0·6d.—call it a little over ½d.—per yard of road every time we do it.

11041. What sort of roads are they? Are they fairly easy roads to clean, or are they difficult to clean?—They are fairly easy roads to clean.

11042. There might be roads where the stratum was very much cut up and where there was a great deal of propping, and where the roof was very friable, in which it might be very difficult?—We have a very great deal of barring and propping done at this colliery; in some of the roadways the bars are quite close together.

11043. So that you think it is a fairly difficult roadway to deal with?—Yes.

11044. Therefore, at a cost of about ½d. per yard you could keep a roadway fairly clean, you think?—Yes, with our system of pit tubs which do not scatter much dust about.

11045. So that if you had smooth and regular roof and sides you could do it for less, probably?—No, I am speaking now of the actual cost of cleaning.

11046. After you have bricked, and after you have done everything that you can do to make the place smooth and regular?—Yes. We have done certain parts in that way; it cost us in those parts a little over ½d. per yard; in other places it might cost about 1d. per yard; but it is not a very costly business if a little trouble is taken over it.

11047. You would suggest that not only should there be this system of cleaning carried out, either by an air jet or by a broom, but that also that the main roadways should almost in every case have a brick floor, and that the sides and roof should be made as regular and smooth as circumstances permit?—Yes.

11048. By iron girders or steel girders?—I think if colliery managers devoted their attention to making their road sides smooth and capable of being swept and kept clean, a great deal of this difficulty with regard to dust would disappear. That is how it occurs to me. I have some sketches here showing how I have prepared these roads. (*Witness produced sketches.*)* You will see the timber is shown; we use steel girders in our system, practically universally in the roof; we prefer wood props and steel girders. Supposing you have a road which has wooden props at the side, we build in ordinary stone packs between these so as to make a rough packed wall, and then we smooth this down in those places with a little rough common mortar. The doing of this is not expensive; we reckoned up what it cost, and doing it in this sort of fashion costs us in Nottinghamshire 3s. per yard.

11049. (*Mr. F. L. Davis.*) What is the nature of your roof there?—It is what we call bind: it is not exactly rock, and it is not clod.

11050. (*Mr. Wm. Abraham.*) Blue bind?—Yes. It is a bind which if it were wet would go back to clay; if it was watered it would go back to dust and would become soft and slippery, but when it is dry it is fairly hard stuff.

11051. (*Mr. F. L. Davis.*) It would crack and come down if it were watered?—Yes.

11052. (*Chairman.*) So that the question of watering naturally does depend always on the nature of the roof to a great extent?—If there are hard rocks—which is not very common near a coal seam—the water might not hurt. But with the ground that I have to deal with in these collieries (I am raising about 1,500,000 tons under my management now), if we had those roads watered we should have very bad roads, and have a great deal of trouble with them.

11053. But where you have a hard rock which is not injured by water, do you say that even in that case it would be better to remove the dust than to water?—I think this happens; when you have a hard rock you nearly always have fairly smooth surfaces, so that the sweeping of dust becomes comparatively easy; the hard rocks have nearly always breaking surfaces which break fairly smooth, so that the rock sides are fairly easy to clean by a method of brushing.

11054. So that you say, in almost every case which you know of, it would be better to clean than to water?—Yes. I think so.

11055. (*Sir Lindsay Wood.*) What is the support between the iron girders?—We have cut some rough boarding timber and slipped it in between the girders, so that the top of the road when done like that is as smooth as this ceiling. This is done with rough boarding.

11056. (*Chairman.*) That is not expensive?—That is not expensive, and it makes a smooth side and a smooth roof; and if you add to this a brick floor I think there is not much chance of dust stopping there, if you clean it.

11057. But you would not suggest as an ordinary thing

* *See* Plates IV and V.

Digitized by Google

Mr. George Fowler.

24 Jan. 1907

that the whole of the roads should be done in that way. You say it might or might not be advisable to do the whole of the roads like that, but that you would insist upon zones being done in that way?—I think so.

11058. (*Mr. Enoch Edwards.*) Have you had any experience at all of an explosion with your system?—I have not.

11059. So that you have not seen it tested as to whether this would be as effective as watering in case of explosion?—No, I am happy to say that I have not had any experience of that sort.

11060. (*Mr. Ratcliffe Ellis.*) But if the dust was entirely removed it would appear to be better than if it was left there and treated in some way to render it harmless?—Yes, I think with a plan of watering, if the watering is neglected at any time the road will dry and the dust will dry and be just as bad as ever. I believe myself that the watering of coal dust on the shales and rocks tends to make it friable and to powder it. If you want to make anything very fine, watering and drying it is probably the best step to take.

11061. (*Chairman.*) But supposing you have only these dustless zones, and you do not keep the whole of the roadway free from dust, surely the ventilation is always bringing in fine dust from other parts of the road, so that almost the moment after you have done your sweeping, the road begins to be dusty again?—I do not think it is so; if you begin at the beginning, and make your pit wagons in such a way that they will not be perpetually scattering fine coal about the pit.

11062. Do you consider that a zone made as free from dust as you well can make it would stop an explosion to the same extent as a watered zone.—Yes, I think so.

11063-4. That is your view, but has that been tested?—No, I cannot say that it has been, because I am happy to say I have not had an explosion.

11065. I suppose you have not made any experiments with a view of finding out in practice how far a dustless zone, although it was dry, would stop an explosion?—I cannot say that I have.

11066. The dust would be driven on by an explosion, and I imagine that when the dust is driven through a watered zone it has a tendency to become wet and to deposit itself and stop the explosion. But, supposing a dust storm was raised by an explosion, I should think there would be nothing to prevent it going through the whole of this 100 yards of dry zone and continuing the explosion afterwards when it met with more dust after it got through the dry zones. I mean I myself should be rather sceptical as to the stopping powers of a dry zone. I quite understand the stopping powers of a wet zone, because directly the dust gets into a wet zone it becomes wet and inexplosive, and in the other case the dry dust is swept along and there is no damp to cause it to deposit itself or to make it uninflammable. I put that view before you?—Yes, I follow the point which you are making. I will not say that I think it has no force, but I equally think that, assuming you have an explosion arriving at the end of one of those dry zones there will be nothing to carry the explosion forward. I do not think the explosion will go through anything so far if there is nothing to burn and nothing to ignite; and if you have these zones clear of dust, if they are dustless, I think they will not convey an explosion.

11067. No, they would not themselves convey an explosion, but the explosion might be conveyed by dust which has already collected, and the question which I want to put to you is whether it has been proved that 100 yards of dry zone would stop the dust in the same way that 100 yards of wet zone does. I understand it is pretty well ascertained that however much dust you have raised by an explosion, and however fast the explosion goes, 100 yards of wet zone will prevent the explosion spreading; but my doubt is whether 100 yards of a dry zone would do so. The dry dust would go right through the 100 yards of dry zone, I should think, and then after it had got past the dustless zone it would come to a dry and dusty portion, and then the dry and dusty portion would mix with the previous effects of the explosion and would continue it?—I see the point; but, assuming there is force in it, I would meet it by making the suggestion of extending the dry zone a little longer. If it is possible to test the point, as you put it, with a wet zone, it is equally possible to test the point with a dry zone, and if 100 yards of that dry zone will not do it, I would make it 200 yards. The point I am driving at is—that I do not want to be compelled in practice as a colliery manager to use water in the way which has been suggested by some of the witnesses. I speak with very strong feeling on the matter, because I have something to do commercially and practically with the conduct of these concerns.

11068. (*Mr. Wm. Abraham.*) But are we to understand that the sweeping of the roads referred to by you was only done in zones? I understood it was done generally?—We sweep the whole of the mine once a year, and the zones are swept—the sides and top—twice or three times a year. and generally we make a point of keeping the roads clean: supposing a wagon gets upset, and the coal has to be picked up, and that sort of thing done, we make a point of seeing that it is attended to.

11069. Any breakage of coal from wagons is filled every day, I understand you to say?—That is so.

11070. All over the mine?—All over the mine.

11071. So that there is no small coal in the ordinary sense allowed to store itself on your roads?—That is so.

11072. (*Mr. Ratcliffe Ellis.*) The question seems to me to be, what is the best way of dealing with dust where it exists and of preventing it from carrying on an explosion? If there is not any dust there, of course there is an end to the question. Your suggestion is that with the system which you propose in these zones there would be no dust?—That is so.

(*Mr. Wm. Abraham.*) According to your system there would not be any accumulation of dust anywhere.

11073. (*Mr. Ratcliffe Ellis.*) There would be in another part of the mine, but in these particular zones there would be no dust to feed the explosion. The question is, can you keep them in such a condition as to be so far free from dust that if at any time you have an explosion in any part of the mine, those zones would be dustless and there would be nothing to feed the explosion, and the fire would stop there?—Yes, I think so. I think if you begin by loading the coal in the manner that I advocate, by the close tub, you will have very little dust at all about the mine. You will find the quantity of dust in this pit set out in my paper, and you will see that the quantity of dust in the mine was extraordinarily little. I am speaking of a mine which was sunk in the year 1842 and which has been working ever since, and has produced a very large amount of coal: it is one of the largest mines in England.

11074. At what page of your paper is it referred to?—Page 9. We measured the amount of dust that was on the sides of the mine when this paper was written, and when I began to look into the point. You see the amount of dust that was on the timber was extremely little:—one thirty-second of an inch and one-sixteenth of an inch.

11075. (*Chairman.*) Do you think this mine is a very dusty mine?—I think it would have been dusty if I had not had the close-ended wagons. When I had it in the first instance it was a fairly dusty mine, when we had the open-ended wagons, and because the roads were getting so dusty I closed the wagons up and had the box tub form of wagon, and that change had the effect of reducing the amount of dust which was made.

11076. Have you had any experience at all of explosions in your mines?—I have not.

11077. No explosion whatever?—No, not beyond a mere capful: once or twice I have had a capful of gas—a little hole fired.

11078. But nothing by which you could test any of your theories?—No, and I trust that I shall not have.

11079. (*Mr. Ratcliffe Ellis.*) I understand that you have tested the effect of the different constructions of tubs on the dust?—Yes, on the dust.

11080. (*Chairman.*) I follow that, but I am referring to experience of explosions?—No, I have not tested that. I take it it is a matter which, in the case of the wet zone, can be tested in the way you suggest, and I shall be pleased to consider any suggestion made in that direction.

11081. Then you do not suggest that the whole of the roadway should be kept clean and free from dust: in fact you do not suggest that that would be possible?—I have not gone so far as to suggest that. I suggest that once or twice a year it might be desirable to sweep the whole of a mine and as the cost is only about ½d. per yard forward I do not think it is a matter which would trouble us. If everybody did the same thing I should be very pleased to do it.

11082. You would sweep up, and then mop up the dust with a little water, and then take it away in wagons?—Yes.

11083. (*Mr. Enoch Edwards.*) If the roadway were swept

Digitized by Google

once or twice a year in what we understand is a dusty mine, that would hardly be sufficient, would it ?—I think dusty mines are generally dusty in most cases because of these open-ended wagons.

11084. Yes, you mean it is a slatternly method of working ?—I think that if a colliery manager who has a dusty mine will close up his box tub he will find that he will not get much dust.

11085. You would not consider that the mines which you are speaking of are typical dusty mines ?—They are not dusty now, because we are using these box-ended wagons. It was a dusty mine before I did that; I think the process the mine has gone through shows the cause of the dust.

11086. (*Chairman.*) But there may be mines which originally were very much more dusty than yours was originally. Do you consider that yours was a typically dry and dusty mine ? Supposing you did not take these precautions, do you consider it would be considered a very dry and dusty mine ?—It is certainly a dry mine. When we are talking about a dusty mine we have to consider why the mine is dusty; the dust is the coal; this coal has to go from the face to the pit bottom, and it is the transit from one to the other that is the cause of the dust. In my case I do not make much dust because I have a close wagon.

11087. But some coal is much more dusty than others, and much more friable ?—There may be a little in that point, but I do not think there is very much.

11088. You do not think that that difference affects the question ?—No, I do not think so.

11089. Then if a mine is dry it must be dusty, in the nature of things ?—The tendency would be to be dusty; but mines would not be dusty, generally speaking, I think, if the close-ended wagon was used.

11090. You go on to deal with the question of ankylostomiasis. I think I will leave Dr. Haldane to ask you questions about that ?—As you dealt with the question of sweeping, may I make a suggestion as to another method of removing dust; assuming, for instance, that in the opinion of the Commissioners and the practical mining world that does not sufficiently remove the dust, I would suggest that a more drastic method is available, and is preferable to the plan of watering. I would draw the dust from the roadsides by a small fan driven by a little motor; sooner than be compelled by legislation to water my mine I should say in a practical way: "Then let me move the dust by a fan sucking up the dust from the back of the prop, or the roof, or wherever it might be, by means of the fan, putting it into closed boxes, in which you could bring the dust to the pit top and get rid of it. I do not know whether you are familiar with the domestic use of the Vacuum Cleaner, or whether you know about it ?

11091. I know about it ?—It is an extremely convenient and useful thing, and the way in which it removes dust from the floors and sides of a house is very wonderful. I see no difficulty in mounting on a tub frame a small fan about 1 or 2 ft. in diameter; the fan would require to be small, because if it were large it would carry away more than dust.

11092. Do you think that would be better than the system suggested by Professor Galloway, namely, that you should get the dust off by means of jets of compressed air ?—That is to say blowing the dust off into the roadway ?

11093. Yes ?—I am trying to deal with it from another point of view. I am trying to bring the dust from the sides and roofs, the timber or whatever it may be, and to suck it into wagons or into tubs or boxes—to inhale it or draw it off from the timber and sides into iron boxes. I believe that would be an extremely easy thing to do. As I say, I would mount a small fan, say 2 ft. in diameter, drive it with a small motor of 2 or 3 horse-power, and connect up with some electrical current—the lighting arrangement at the pit top would probably be adequate—with a small cable, and let sections of road be cleaned in that manner at certain times. If you had a fan with a few yards of pipe and a small nozzle, it could be put to the side of the road or behind the timber, and you could suck the dust from that, and the fan would convey it into the closed box and would deposit it there, and then that box with the dust in it could be brought to the pit top and tipped over the dirt hill.

11094. That might be less expensive than the sweeping process ?—I do not think it would be less expensive than the sweeping, but it would be very much less expensive than watering. That, I think, would remove the dust from the back of timber and would remove it up above, and would suck the dust out of cracks or joints in the rock. I believe that would be quite a practical and feasible way of dealing with the matter. I think the sweeping ordinarily is sufficient; but assuming that you advise, or the legislature adopt the view that there must be no dust at all in the mine, I should say then "Permit me to try and use that, if you please."

11095. You wish to show the Commission samples of coal dust which you have brought. Dr. Haldane is here now, and would probably like to see them (*samples of coal dust produced*) ?—My point is that the dust of roads ordinarily speaking, is the dust of the roof rocks. Here is a sample of dust which has blown from the top of the tubs.

11096. (*Dr. Haldane.*) This dust is from a main road ?—Yes. *This* is a sample of dust from a travelling road; that is mainly in the roof rock which, when the roof rock slips, is ground up by the men's feet. *This* is dust which is collected on timber, and of which, as I say, there is only a small quantity which might be swept or blown off; but you see that is black, and it is very carbonaceous, no doubt; that is very fine, and it would be inflammable, no doubt. Some years ago I wanted to stop the use of gunpowder, and to use Bellite. That was when the rules as to explosives were made more stringent, and I was very desirous of getting the thing done smoothly with the men, because they often raise very great difficulties indeed in regard to making changes. I had a heap of dust put over a cartridge of powder, and a similar collection of dust over a cartridge of Bellite, and exploded them out in an open field. The cartridge of ordinary explosive gunpowder made a tremendous flame up in the air 30 yards high, but the Bellite cartridge simply sent the dust flying away and no flame occurred. That little demonstration before 40 or 50 of the men enabled me to put the thing right through my mine without any trouble at all.

11097. (*Chairman.*) Do you go so far as to say that it would be unnecessary to water the vicinity of a shot when it is fired ?—On a main road, do you mean ?

11098. Yes ?—No. I think if you fire shots in a main road it is desirable to sweep and to water slightly. I approve of that.

11099. You agree with the present rule, which says that where you fire a shot you must water 20 yards around, and you propose to keep that ?—Yes, on the old-established main road away from the faces.

11100. The rule is that it is to be done wherever it is, whether it is a main road or not. If the place in which the shot is fired is dry and dusty you must water 20 yards round it. Do you think that rule is necessary ?—Yes, on a main road.

11101. But it is nothing to do with a main road. General Rule 12 says: "If the place where a shot is to be fired is dry and dusty then the shot shall not be fired unless one of the following conditions is observed, that is to say—(1) Unless the place of firing and all contiguous accessible places within a radius of 20 yards therefrom are at the time of firing in a wet state from thorough watering or other treatment equivalent to watering" ?—Does that apply to faces ?

11102. That applies to any places where a shot is fired. I suppose you would say that if for 20 yards round a shot the place was swept absolutely clean of dust that would be treatment equivalent to watering. Perhaps it would be equally efficacious, in your opinion, whatever the law may be ?—I think there is much to be said for using a syringe in roadways. We very rarely have to fire shots in roadways away from the face. I think it is undesirable to do it if it can be helped. I have made the rule myself, in point of fact, that, although I am not the manager of any of the pits, if work has to be done on main roads between the working faces and the pit bottom, the matter should be mentioned to me personally and should be discussed.

11103. Do you think it would be well to prohibit shot-firing altogether except between shifts ?—On main roads I do—I should prohibit it altogether.

11104. I have not asked you anything about ankylostomiasis, because I thought perhaps Dr. Haldane would deal with that question ?—Yes.

11105. (*Sir Lindsay Wood.*) I think there can hardly be two opinions with regard to your recommendation that if the tubs are built in a box shape that would prevent coal dust coming on to the wagon-ways ?—Yes.

11106. I suppose the difficulty is in filling these large pieces of coal which they get in some of the high seams; is

Digitized by Google

Mr. George Fowler.

24 Jan. 1907.

not that so?—That is so, and it is met, I think, by making one end of the wagon a little lower.

11107. Would it not also be met by rather ending up the tub? In the North of England, where we have in some parts fairly high seams and large blocks of coal, the front wheels of the tub are allowed to go over the ends of the rails, which gives it a cant up, and which of course lowers the other end of the tub some 5 or 6 in.?—I have not seen that done.

11108. It is the practice in the North of England?—It is new to me. But with large coal and with a shorter height we lever a few inches—make one end of the wagon a little lower—and then pack large coals at that end, so that it prevents coal being shed about the road. It is the stopping of shedding of coal about the road which I think is the first step to getting rid of the dusty conditions of mines.

11109. With regard to dust coming off the screens, you say that your screens are 100 yards from the shaft?—Yes.

11110. Do you mean the first tipping of the wagon on to the screen is 100 yards from the shaft?—No, I do not mean that.

11111. Is not that one of the chief causes of making the dust?—No, I do not think so. I think the shaking of the screens makes most of the dust. I think coal may be tipped over, and it may make a little dust, but not very much. But that might be dealt with by some of the methods which have been suggested. I am speaking, of course, of collieries in which we use a tipping belt, which is almost universally used now in the Midland counties; it is a belt which is generally 80 or 100 yards long, by which the coal is necessarily obliged to travel some distance away from the tipping point. I concede that the tipping arrangement may make some dust, but I think the screens make most of the dust. I think it is probably advisable that the tipping arrangement should be some distance away from the pit top. As a matter of fact, in my own practice I have laid out two or three collieries with that intention, that the tipping arrangements should be away, because it gives more room for stock wagons to accumulate, so that the tipping goes on continuously. I think in nearly all my collieries the tips are 30, 40, or 50 yards away from the pit top. We do not in the Midland counties as a rule have our tips very near the mouth of the pit.

11112. But 30 or 40 yards would hardly stop the dust going down the downcast shaft, would it?—It might depend upon the way of the wind, but I think in the mines under my charge the surface arrangements contribute very little to any dust. I think very little dust goes down from the banking and screening arrangements.

11113. I was going to suggest another method—namely, to case the down-cast shaft in the same way as you encase an up-cast shaft—making it like a tube well above the screens. Would that prevent it?—If dust arose from the cause you mention I think that method would be a very good one. I think it is a very good suggestion that you should admit the air going down to the pit from the level of the pulley wheels at the top of the head gear, and admit the wagons into the pit top which are going down the pit as they have been emptied from the tipplers and screens, admitting them through doors and so sending them down to the pit. I think the suggestion that the in-draught of air going down to the mine should be taken some 30, 40 or 50 feet above the ground level is a very good suggestion indeed.

11114. Of course, there are many instances in which it would be perfectly impossible to have the tipping of the coal on to the screens 100 yards from the mouth of the shaft, owing to the configuration of the surface?—Yes, I understand that—particularly when you have your tip raised some 20 or 30 yards upon staging, which is common in some parts of the country. I think the process of admitting the boxes through doors on the on-set level would help very much to meet the difficulty of dust going down the shaft. If I may venture to say so, I think it is a very good suggestion.

11115. With regard to the question of the paving of main roads, I suppose your suggestion is as to such roads only as are not the subject of heaving and the floor of the mine rising. In many mines the floors and roadways are continually lifting or heaving, as we call it. How would it do to have paving with brick-work for that purpose when that takes place?—First of all, broadly speaking, my suggestion was more particularly with reference to roadways which do not heave much. If a roadway is subject to heaving, and is constantly heaving, you have to keep lowering it, and to do that you take material away, and you would in that manner obtain a new surface and would be clearing away the dust or accumulation of whatever might be at the surface; then the dust would go, and your new roadway would have a fresh surface. Therefore, if there was accumulated dust or dirt, that operation would deal with that and would move it away. You would get down into the shales, and so forth, below the coal. Also I think that very often paving a road would stop heaving. I have heard practical men in charge of collieries say that even the weight of a rail will stop heaving. That, of course, is ridiculous. I do not think so myself; but I do think that very often the heaving of a road may be occasioned by water soaking in the material. Either air or water getting in the shales might help the swelling and heaving, and I think the effect of paving would very often be to prevent that and to save the road. Then, assuming that a paved road does heave, it does not carry away the bricks, and you have still got the bricks, and you can lay them back again. It heaves up your paving and dislodges it, but it does not destroy your bricks, and you can take your bricks away and lower your road and pave it again. That cost of paving is so very small that very often I think paving is an economical device, and is a good practice from a mining engineer's point of view. I think paving might be done in collieries to a greater extent than it is. I should desire, as a colliery manager, to say that I think we are all too careful about using paving, and I think that if we used it more freely we should get cleaner mines and roads which would stand rather better in practice. Take, for instance, one difficulty which very often occurs in a colliery: you get a tram off the rails, and it has to be got on again. If you have a paved road and the road is level with the rails, it is quite easy to get the wagon on again; but if, as is very often the case, you have a sleeper and a rail, and the roadway itself is three or four inches below the railed surface, when you get the wagon off you have the men heaving and tearing to get the wagon back, and time is lost and expense incurred. Whereas, if your roadway was level with your rails, by means of pitching or flooring it with brick, you would get a much better road and your wagons are easily got on again. I think in practice, brick paving might be done with advantage very much more frequently than it is done.

11116. Do you think it can be done at a cost of 2s. or 3s. per running yard?—Yes, I think so, reckoning bricks at 15s. per 1,000, and you may get brick paving done at about 6d. or 8d. per square yard with dry bricking. It is not a very expensive thing to do, and a very moderate man would do that. We have now in practice very often to find work for disabled men, and a job of that sort they would very often be able to do. I think it is a good practice to introduce paving more than it is done in the practical working of a colliery.

11117. Speaking of cost, I think you mentioned the price of 15s. or 16s. per 1,000 for the bricks, did you not?—Yes.

11118. That is only half the usual price, is it not?—Well, most collieries make bricks, and I have seen an advertisement of bricks being made at 5s. 9d. per 1,000. As a matter of fact, I think a good hard brick out of pit shale may be made for about 15s. per 1,000.

11119. I understand you think that the dust would be sufficiently removed to prevent an explosion spreading if it was swept once or twice a year?—I think so; that is, if the pit wagons are arranged in the manner I suggest.

11120. Whatever amount of dust was made?—Yes.

11121. Some of the inspectors have said in their reports that even watering 24 hours before an explosion took place did not prevent the explosion spreading?—I can quite believe that with watering that may be the case.

11122. But you do not think it would be so in the case of removing dust?—No.

11123. Do you think that if the General Rule as to watering before firing shots in a main road was very stringently enforced, with even a larger distance than 20 yds., it would be the means of preventing many of these large explosions?—I am disposed to think so. I think colliery managers would be wise to see that the use of explosives on main roads was brought more definitely before them themselves. It is rather disagreeable to mention specific cases, but I have in my mind two cases in which I have reason to believe misadventures happened when an explosive need not have been used at all. The under-people of a colliery are too apt to think that if there is a bit of rock sticking out, and so forth, they must put a shot in and get it away. I think it would be wise for colliery managers to discountenance the use of explosives on main roads

Digitized by Google

as far as possible, and one way of doing that would be to bring the staff a little more under their control, from that point of view. A little time since, I wrote in my memorandum book, before my under-managers and managers at Babbington, this instruction—that no explosives are to be used on main roads without the circumstance under which they are required being brought on the Friday (the day on which I see these men) before me and discussed generally before the whole of the managers, so as to bring the circumstances directly under my own personal knowledge. I think the fact of it being an easy thing to put in a shot and to knock off a bit of side and so forth, makes men use explosives when very often they need not do so. I very much discountenance and dislike the use of explosives on main roads where dust will collect, which will be a difficulty do what you may. With regard to the faces themselves, I do not think there is much to fear, but on the roads I very much dislike the use of explosives if it is possible to do without them, and I would sooner spend a little more money in cutting away a piece of projecting side, or this or that, than fly too easily to the method of putting in a shot. That is my own judgment and feeling on the matter.

11124. That is practically what was suggested to us yesterday by Mr. Galloway. It is the practice in some mines to my own knowledge that no shot is fired on the main road without the permission of the manager?—I see the staff at all my collieries practically every week, unless I am away, and I have five or six of them at this place at Babbington before me once a week; then matters of this description I like to have brought before me and discussed, and then I know something about what is being done.

11125. Do you think that if those precautions were taken it would lead to preventing a large number of deaths from explosions taking place?—I think so.

11126. I gather you would rather adopt any means of stopping dust than the means of using water?—I would certainly. I very much dislike the idea of using water, because I have now good roads in my mines, and I do not think I should have good roads if I were compelled to water.

11127. But that would be very much the case in many mines, would it not?—Yes, I think it would.

11128. (*Mr. Wm. Abraham.*) Do you have shots used in the face at all?—Yes, if necessary.

11129. What is your mode of dealing with shots in the face?—First of all they are fired by shot-firers or deputies; we do not allow the men themselves to fire them.

11130. Is that being done during the shift?—Yes, certainly—while the coal-getting is going on.

11131. Do you use coal-cutting machines?—At present we do not.

11132. Have you been using them?—I am proposing in one mine to use a coal-getting machine, but at present I am not using coal-getting machinery anywhere.

11133. Do you fill out all the small from the faces, or do you leave some small behind?—In one colliery we are filling all out: in the other collieries we are filling only the coal that can be loaded by hand. In one case a very little is left behind; in other cases no doubt some is left behind, and it remains in the gob.

11134. Do you allow shots to be fired in cases where you allow coal to remain in the gob?—Yes; it does not occur to me that circumstance is material.

11135. Do you think the small which is left has not the same dangerous element as what is left on the timber?—No, I think not.

11136. How do you reason out the matter; is it a safe custom in a dry and fiery mine to allow any small coal at all to remain in a working place?—I am bound to say that from the point of view of safety it has never occurred to me that that was material. I do not think that there is any fear of the small coal as cut arising from the getting of it in the face, exploding by a shot; it is only very fine dust, like that which I have collected in those bottles from the roads, which I think is explosive with a shot. I do not think that the small coal in a stall and a working face will fire in that manner; that is my judgment.

11137. Even when there is an emission of gas do you think there is no danger in leaving it there?—Do you mean if the gas were fired?

11138. Yes; of course, as you know, gas is emitted when you are working the coal—that is the chief emission of gas. Supposing by some means or other an explosion occurred by shot-firing where gas is emitted, would not the fact that you have small coal left behind in the face increase the danger?—I do not think it would; I think that small coal gets buried behind in the gob, and that whether you filled it or not it would not be material. Two or three yards behind you there may be a little small coal, or there may be only just roof stuff, and so forth. I do not think it would matter very much. I am not prepared to say that, assuming you have some men filling at the coal face with the coal before them, large and small, if an explosion occurs, the effect would be that this material would be absolutely neutral to the explosion; but whether you fill it up and send it out of the pit, or whether you throw it back behind, I do not think makes much difference; you have it in any case, and you cannot avoid it, and it is your business to deal with it. That it is absolutely neutral, assuming an explosion from gas went on, I could not say; I believe it would add to the effect, but I think that whether you send it out from the pit or whether you put some of it back in the gob matters very little.

11139. Very well. I will not pursue it any further?—May I add that on the whole I think the tendency undoubtedly is to fill up the whole of the coal cut and to send it out of the pit very much more than it was. It pays better now to send it out than it used to do; the price of the small coal is very much better than it used to be.

11140. Being a practical mining engineer you have seen faces where the coal is so brittle that you have to keep up your gob within a foot of the face of the coal?—The gob within a foot?

11141. Yes?—How do you get there?

11142. That is the point; have you seen coal worked in that way. If you speak of two or three yards I agree with you, but when you have to keep the gob up so close, with any small coal so near, should a shot cause an explosion, would that not state of things necessarily increase the danger? That is the point I wish to deal with?—I could not say. First of all I do not think that in any colliery I have to do with the gob is so near the face, unless we happen to have a very thick holing dirt—under clay. I have one case where we do pack up very closely to the face before we begin to hole, but then that is stuff which certainly would not burn in any case; it is simply hard clod and clunch; and that is walled up to the face and makes a very nice wall up to the face; I am not at all afraid of that firing, and I do not think there is any risk from that.

11143. But the cause of the gob being so close with you is that it would be in the bottom and not in the top, like it is with us?—It is a result of excess of bottom.

11144. (*Mr. F. L. Davis.*) But you are taking rather an extreme case, are you not, when you put it within a foot of the face?

(*Mr. Wm. Abraham.*) Yes, it is not common; but I know what it is in practice myself personally.

(*Witness.*) Under-clay, when it is thick, does get walled up, no doubt, pretty close to the face; but then there is nothing explosive about it—it is not coal at all.

11145. (*Mr. F. L. Davis.*) I think Mr. Abraham's meaning was the gob being so close to the face, not because of the bottom, but because of the bad top?—Yes.

11146. (*Mr. Wm. Abraham.*) That is so. I do not know whether it is your experience, but do you not have gas emitted from the top as often as it is emitted from the coal; if the top is of soft shale, does not the gas oftentimes come from the top—from the roof?—Sometimes you may have a thin seam of coal, which is used and made useful to help you to make a roof, and that sometimes contains gas; I am prepared to admit that it does.

11147. Then supposing you get that on top of a 6 ft. seam, that would be a source of danger if shots were fired under those conditions—where gas is present and small coal is used to make the gob, tons of it, say?

11148. (*Mr. F. L. Davis.*) But may I say a word here? Is not that small coal which is put into the gob very much bigger and coarser small coal that the dust which is likely to cause explosions?—Yes, very much indeed.

11149. It is quite a different class of dust; you would not call it "dust"?—It is generally mixed up with a lot of shale, and so forth. Mr. Abraham suggests a point as to how it occurs to him, as a matter of safety in working a pit with regard to the subject that he mentions; but I am bound to say myself that I have never looked upon the gob and the amount of small coal and so forth in it as being, to my mind, in any way a source of danger in working the pit. That is how it occurs to me.

Digitized by Google

Mr. George Fowler.

24 Jan. 1907.

11150. (*Mr. Wm. Abraham.*) That will suffice; I simply wanted your opinion with regard to it?—I think that is how I should like to put it.

11151. Now coming to the question of wagons, having wagons conveying the coal in dry and dusty seams—gaseous seams—the bottom built with bars having two or three inches of space between, is that kind of tub commendable?—An open framework tub?

11152. Well, I have not come to that; I am dealing with the bottom?—With bottom bars?

11153. With bottom bars, with two or three inches space between the bars—a kind of a griddle. Is that commendable in a dry and dusty seam?—I think not.

11154. You would condemn it?—I would.

11155. Supposing you had a tub in addition to that, with simply two bars at each end, and with both ends of the tub open, and large lumps of coal, of course, being used to build up the tram; in a dry and dusty gaseous seam would that kind of tram be commendable?—I think not.

11156. Leaving coal dust to accumulate on the roads to the extent of two, three or four inches thick; is it safe?—I am bound to say I think not. I have said all along, get away the dust—remove the dust.

11157. Allowing breakages of coal to accumulate for two, three or four days without being re-filled; is that dangerous?—I think so.

11158. As to your system of pitching roads, that is to say, pitching them with brick, and sweeping, and so forth; can that be done cheaper than watering?—I think so.

11159. Is it as safe as watering?—I think I have already said that when you are dealing with a pitched road it may be convenient occasionally to have a barrel of water to assist you in collecting the dust. But on main roads, particularly at turn-outs like that, I am in favour, when you possibly can do it, of introducing a paved road, and keeping that clean.

11160. Your opinion is that a system of cleaning the roads is the one thing necessary?—That is what I think.

11161. Filling the small coal, the horse-droppings, and so forth, together would make it easier if it is done often?—I think so.

11162. (*Mr. Ratcliffe Ellis.*) You have a very strong objection to watering?—I have.

11163. Will you be good enough to put before the Commission the grounds of your objection; what, in you view, are the disadvantages of watering?—Do you wish to introduce the element of cost?

11164. No, I mean the disadvantages physically?—I think that a plan of watering the sides and top of a mine will in most cases weaken the ground and make it difficult to keep the roads of your mine square, good and workable; that when you use timber it will tend to rot that, and to introduce mould and that sort of growth. In some mines I have seen a great deal of timber simply destroyed quite quickly with fungus in that way from watering; and if you are using steel, I think if you are constantly watering it, the steel will soon rust away and waste, and you will get it damaged and more or less destroyed, and the whole ground about you will, I think, be weakened and rotted, and made less easy to keep a good road upon. That is my strong objection to it—I think you would have bad roads.

11165. By far the greatest number of accidents underground arise from falls of roof and sides?—Yes.

11166. Have you any opinion to offer as to whether those accidents would be likely to be increased if watering was general?—Speaking generally, I should think that effect would very likely ensue, that inasmuch as the watering would tend to weaken the sides and top of your road you might reasonably expect that you would have falls, and so forth, more frequently, and it would be consequently more difficult; and in parts of the country where the top and the sides are very weak now, I am quite sure watering would be a cause of great difficulty. May I mention the experience of other persons in this matter?

11167. Certainly.—As a matter of fact I have the pleasure of knowing in Warwickshire the manager of a colliery who is an exceedingly acute and able man. I think he is one of the best colliery managers I know. His mine happens to be situated between two mines in which I am myself interested, exactly half-way between. I sent him a copy of this *precis*, and asked him his opinion on what I was going to say, and he approved generally of what I did say, although I think he was not quite as convinced as I am that it is possible to sweep; but he said, "For goodness sake do not let us have any plan of watering, if you please; we have enough difficulty now in keeping our roads workable, and if we have to add to that a plan of watering I do not know where we shall be." I have myself just opened a large colliery in which I have some difficulty now in keeping my roads open. If we were compelled by law to add a system of watering, I think we should be almost disposed to throw up the business and make an end of it.

11168. That is the disadvantage in Warwickshire?—That is the disadvantage in Warwickshire, where we have particularly bad ground to deal with.

11169. From your experience, which, of course, is much wider than Warwickshire, do you think there are a great many similar conditions in other mines in other counties where watering would be very disadvantageous?—I am very strongly inclined to believe that that is the case.

11170. According to the German system, they have a provision for universal watering, that all mines should be watered, but there is a provision that exceptions can be made in certain cases. In your view, if there were such a general rule in England, would the exceptions be a larger number than the number of cases in which watering could be carried on without any damage?—I am disposed to think so. I think, for instance, taking Nottinghamshire, Derbyshire, and Yorkshire, where silkstone or black shale coal is largely worked, the whole of the black shale collieries would be compelled to get exemption from that point of view. I have been consulted recently with reference to some black shale collieries, and the enormous difficulty of keeping the roads open was brought very prominently before me by the managing director of that concern.

11171. You recognise now to the full the danger of an accumulation of coal dust of an explosive character in mines?—I do.

11172. You have directed your attention to endeavouring to get rid of this danger by some other method than watering?—Yes. You see I wrote this Paper in 1896, ten years ago.

11173. You have been good enough to supply us with a tracing.* I do not think there is any explanation on the notes of what this tracing means. Will you kindly explain the effect of it?—This is a plan of the workings of the large pit near Nottingham with which I have been experimenting on the question of making it as little likely as possible to be explosive from dust. You see there are three shafts which are marked as downcast and upcast. Then you see a roadway running to an upcast pit on the left-hand-side of the drawing. Then you go up towards the top of the drawing, and you see a section of 300 yards, and then to the right again you see another section. Then, coming back to the bottom of the drawing, where the three black marks are, there are the three pits, and looking to the right you see two sections of 300 yards each. You see on that plan five sections, which are lengths of something like 300 yards or so, where we more or less effectively sweep and keep clear from dust with a view to preventing explosions spreading.

11174. Why are those particular localities selected?—Because they are between the working faces and the shafts—they cut the pit into sections.

11175. And those are the areas where, in case you had the misfortune to have an explosion, its effect would be stopped?—I am hoping so.

11176. And it is in those particular areas that you propose to clear away the dust altogether?—Yes.

11177. You have already said, I think, that in your view, if you have wagons so constructed as to make the amount of dust as small as possible, you would be able effectively to clear those areas from dust to such an extent that at any time, if there is an explosion, it would be stopped at one or other of those areas?—I think that, supposing legislation took the form of making it compulsory either to water a mine or else to make sections of a mine perfectly dustless, I could make parts of those places marked in blue on this plan practically dustless. I should do that in practice a good deal more than I have done already. You see these are things which I did ten years ago with a view of illustrating a point, and that I could not do better or make it more complete I do not affirm; I think I could. But I think I am on the right lines to make what are perfectly dustless sections.

11178. You would not object, I suppose, if the view was taken that it should be dealt with in this way—that certain areas of the pits should be made either dustless or wet, leaving it optional either to prevent the explosion spreading along by removing the dust, or by dealing with the dust

* *See* Plate VI.

Digitized by Google

ROYAL COMMISSION ON MINES.

BABBINGTON COAL CO.

CINDER HILL PIT.

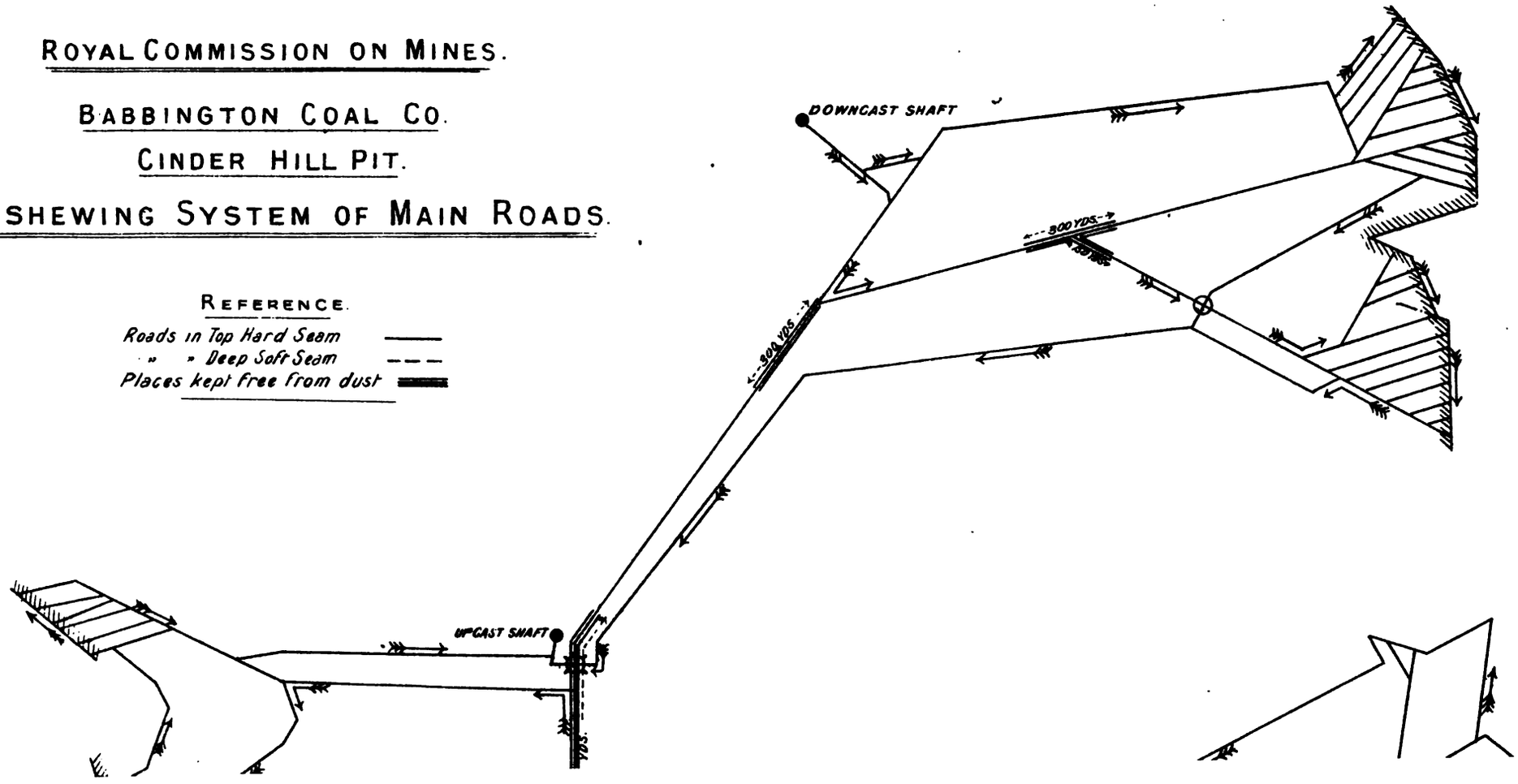
PLAN SHEWING SYSTEM OF MAIN ROADS.

REFERENCE.

Roads in Top Hard Seam ——

" " Deep Soft Seam – – –

Places kept free from dust ▬▬



Digitized by Google

Mr. George Fowler.

24 Jan. 1907.

Digitized by Google

Digitized by Google

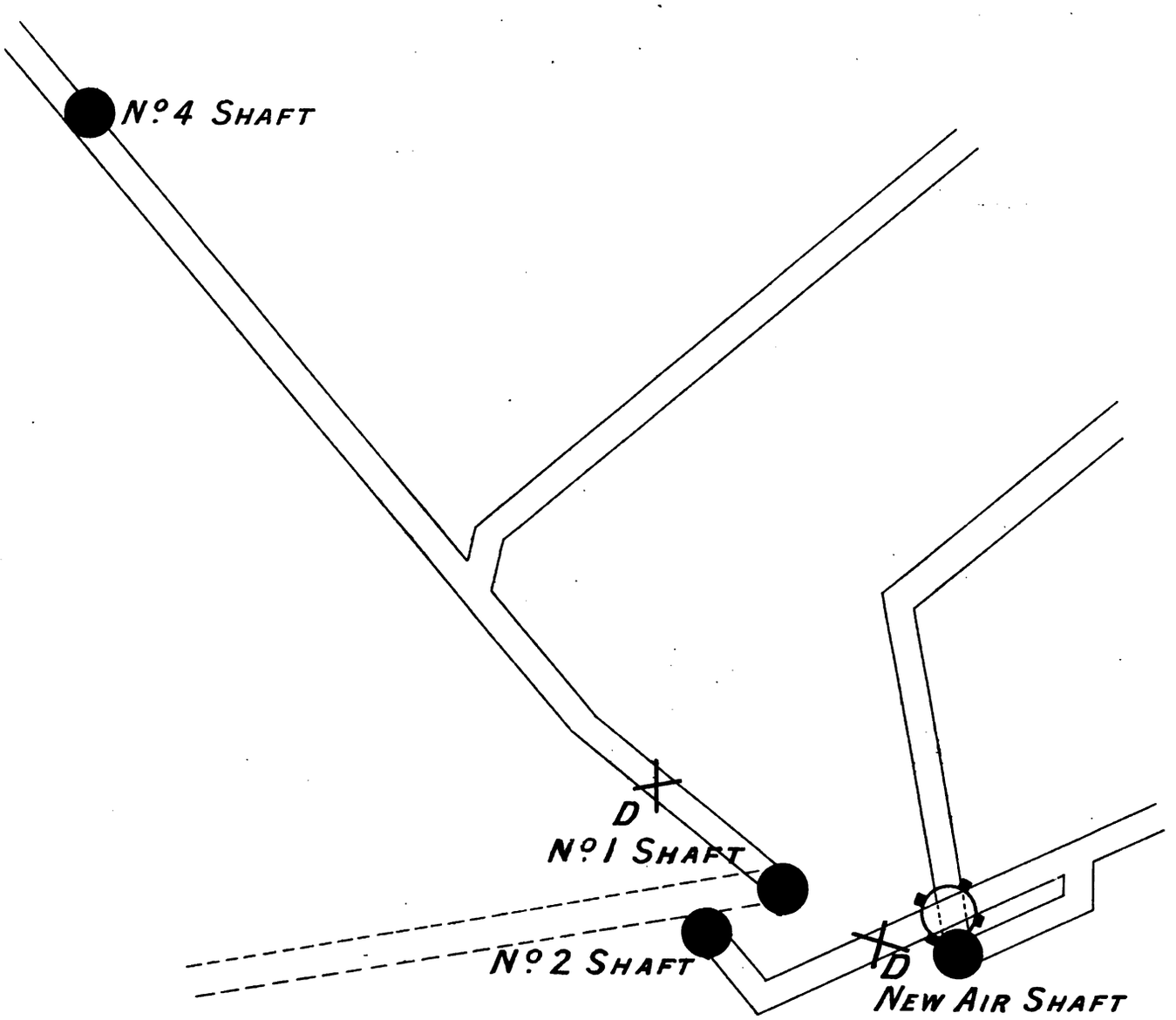
ROYAL COMMISSION ON MINES.

BABBINGTON COAL CO.

CINDER HILL PIT.

PLAN SHEWING POSITION OF EXPLOSION DOORS.

SCALE 1 CHAIN = 1 INCH.



REFERENCE.

Position of Doors shewn thus..... D X

" " " " " .....

Roads in the Top Hard Coal " " .....

Road in the Deep Soft " " " .....

Digitized by Google

Wellan & Graham, Ltd. Litho London.

Digitized by Google

ROYAL COMMISSION ON MINES.

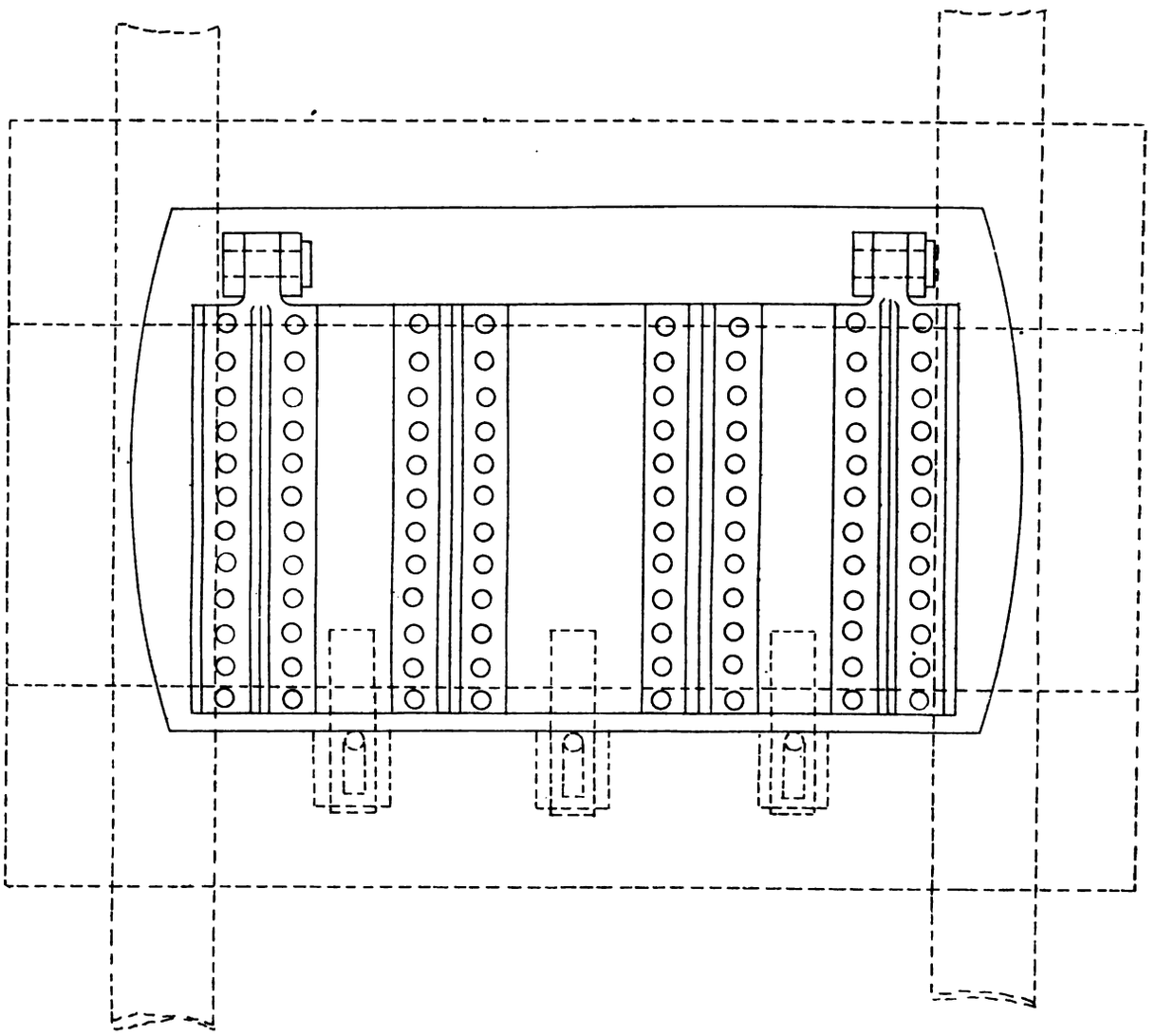
BABBINGTON COAL CO.

CINDER HILL PIT.

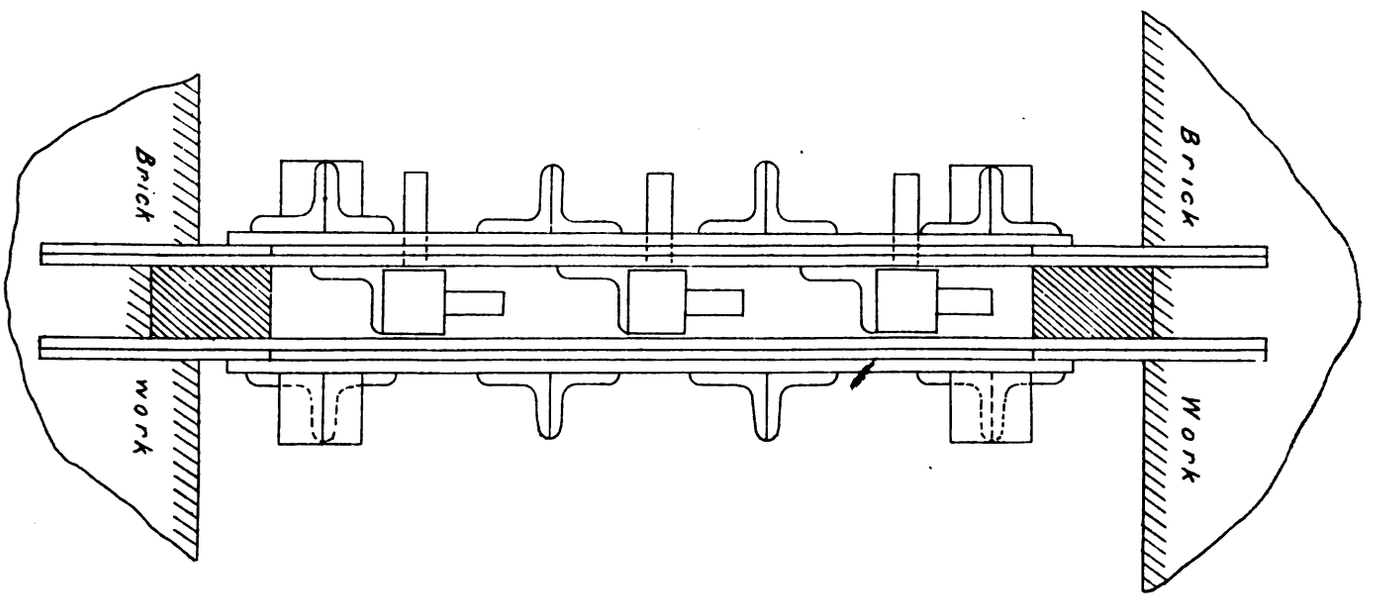
PLAN OF EXPLOSION DOORS.

SCALE 1/8TH FULL SIZE.

FRONT ELEVATION.



SIDE ELEVATION.



Digitized by Google

Weller & Graham Ltd Litho London.

in those particular areas by watering or in any other way? —No, I think I would not: I mean I should be perfectly content to leave it optional. I think I can see no objection to that: I mean, another mining engineer might take quite a different view, and he might say "I am very fond of water, and I will put water about." As a matter of fact I would rather not. It occurs to me that at the collieries with which I have to deal I should have a difficulty in finding water: in the summer-time at this particular colliery I have a difficulty in finding water to keep my boilers supplied, and I have a difficulty in Warwickshire. At all my places I should have a difficulty in finding water to do these things in the summer, and that would be probably the time when it would be most wanted. I do not know whether in any of the calculations which they have made for watering they have considered whether water might have to be bought at something per 1,000 gallons, or that it might be difficult to get at all: but that is a real difficulty.

11179. Then your general view is that the danger of an accumulation of dust carrying on an explosion might be prevented by these protected areas?—I think so.

11180. And that they might be dealt with either by watering, so as to render the dust there harmless, or by removing the dust, as each manager might think best?—Yes. Then I would go further and say this; I would say to colliery managers as a whole, "I direct your attention to the point of removing dust from your roads more thoroughly than you have been in the habit of doing." We have all of us looked at the difficulty of dust, and we have none of us set our minds to work to get rid of the dust. I say that the method of removal of dust from the sides might in all cases be used with advantage. In this colliery we reckon more or less to sweep the road once a year round: it does not cost very much, and I have the question of cost to consider in the management of the colliery.

11181. You see we have to consider different pits under different conditions: in some cases the managers might prefer to use water, and in other cases they might prefer to remove the dust. But I understand your point is this, that if the attention of managers is particularly called to the fact that dust can be more easily removed than it is at present, it would be more often attempted?—Yes, I think so. Do you mind referring to my scheme of the fan?

11182. You refer to the method of removal?—Yes.

11183. First of all you said that what you do now is to brush with brooms and brushes and to fill the dust into tubs and then take it up to the top of the pit. You think that use might be made of a suction arrangement?—I do.

11184. That would be a little motor with a fan, and you would work it all round the roof and the bars, and clear them in that way?—That is it. I think that a small fan of that kind and a motor would probably cost £50 or £60. I do not think it would cost more: and if it were mounted on a wagon it could go along the road and be used where wanted. Then if a small cable was reeled on a barrel and mounted on another wagon, I think it would be possible to take a current from some main motor on the colliery to points at which you could suck this dust away from the timber and convey it by that means into wagons. In point of fact it would get dust away from roof timber better than any other means, because you could take the receiving nozzle of the thing and push it behind the timber, or push it up behind openings in the roof, or opposite cracks in which dust might be located. I think you might remove dust very easily and very inexpensively by that means, after having provided yourself with your apparatus.

11185. How often do you think that operation would have to be performed?—Probably two or three times a year.

11186. Not more than that?—No, I think not. I say start first of all with a box tub, and I think the dust will not trouble you in the way in which it has done. That is my experience.

11187. The roads at the points of these protected areas, whether they are to be protected by water or by the removal of the dust, would have to be constructed somewhat differently from the rest of the roads. If you have to brush your dust away, you want the roads constructed in the way which you explained on your plan, more or less smooth?—Yes, with smooth sides.

11188. And I suppose if they have to be watered they would have to be specially constructed so that the water might not damage the strata, or so that it would do as little damage as possible?—I do not see how you could manage that with water.

11189. In these protected areas?—The protected areas for sweeping you make smooth in the way I suggest: a little pick-work or trimming would tend to do that.

11190. In the case of watering, how would you prepare your sides for that?—You see I am not an advocate for watering, and therefore I have not considered how I would do it.

11191. May we go now to the question of explosives and the doors?—Yes. That is quite a different point.

11192. (*Chairman.*) I understand that is another alternative, a third alternative, to prevent the spreading of explosions?—No. This plan has no relation to that at all.

11193. I thought that these doors were intended to stop an explosion going from one part of a mine to another part?—Yes, in that sense they are.

11194. Is that not a third alternative? The use of watering is to prevent an explosion spreading, and, as it were, to have some part of the mine where the explosion stops; you can either stop the explosion by a wet zone or perhaps you can stop it by a dustless zone, and then if you do not adopt either of those methods you may also stop an explosion mechanically, by having doors put so that the explosion cannot travel beyond the door, but the door stops it and stops not only the explosion but the afterdamp. Is not that your idea of the doors?—No. I am afraid I am not quite in a position to express an opinion as to that. The doors shown in the sketches* are intended to meet quite a different difficulty. They were to sever two completely different sets of workings which communicated with each other at the shaft itself, and it was only with reference to their connection at the shaft that these doors were put in, with which this particular plan has nothing to do. I have no scheme in my mind now to put explosion doors, as I might call them, at any of the dustless sections I have referred to: I am not proposing to work a traffic to draw coals through or to have the ordinary conduct of the mine through these doors or at points on this larger plan where the sections are shown.

11195. But still I understand that the reason you put those doors there is in case there should be an explosion which would burst through all your barriers and your dustless zones, or your watered zones, or what not—in case there should be an explosion as there was at Courrières, which travelled all over the behind portions of the mine; that you would prevent it spreading from one portion of the mine to another by these doors?—Yes, that is the object.

11196. I should have thought that might be fairly described as an alternative method of preventing the spread of an explosion?—From one mine to another—that was the intention. Mr. Stokes had not seen these doors. May I tell you how they came to be put in? When the Courrières accident happened, I saw that the calamity assumed the proportions which it did owing to the fact of several collieries being connected, so I thought, "Is there anything in my own practice which might be made better from that point of view?" and it struck me that at this particular colliery where we happened to be working two seams of coal, one 160 yards above the other, and where the shafts were in connection with both, I might with advantage cut off one pair of shafts for the use of one seam and use the other pair of shafts for the other seam. Then, inasmuch as I wanted to have a connection between the shafts at the level of the upper seam for various uses and for convenience, I thereupon built dams or stoppings round the shaft at the upper level. In two of these dams I put doors to give the men access from one to the other whilst maintaining the closing off of one set of workings from the other. That is the history of those doors. They are quite small doors about 2 ft. 6 in. high, and just under 2 ft. wide, made of thick steel plating riveted with strong stiffeners, very much stronger really than the doors of a safe, and they close on the frame, both opening in opposite directions. That fire-screen which I see here very fairly illustrates the operation; if you put up that fire-screen and have one valve working *this* way and the other the other way, on whichever side the explosion occurred the doors would be driven in by the explosion. I used some 50 lbs. of steel rail to stiffen them; they are enormously strong steel doors, which I do not think any explosion would move. If an explosion occurred and a man wanted to escape from one seam to another, he might get to either side and get through. That was what was in my mind, and I think

* *See* Plates VII. and VIII.

Digitized by Google

Mr. George Fowler.

24 Jan. 1907.

under the circumstances which we had to deal with on the whole I did a useful thing by putting those doors in. I think it may be very well worth while bringing the suggestion before other colliery managers who may happen to have somewhat similar conditions.

11197. Would you suggest that the legislature should intervene in the case of collieries which inter-communicate to any great extent underground, and that it should be made unlawful to have any inter-communication beyond a certain distance which might be specified in an Act of Parliament?—I am disposed to think that if a suggestion of that sort was brought before the notice generally of colliery managers actively engaged in mining operations, that would be quite sufficient.

11198. (*Sir Lindsay Wood.*) Are not these simply what we may call separation doors to divide the currents of air which are continually being used in the mine and are continually shut?—Yes, they are to sever one set of workings in an upper seam from the workings in a lower seam.

11199. But they are always kept closed?—They are always kept closed.

11200. They are not simply closed when the explosion takes place?—No. They are always kept closed.

11201. So that they are the means of separating one set of ventilation from the other set of ventilation?—That is so.

11202. Have not many lives been saved in explosions by the mere fact of such doors being blown away so that the afterdamp got a shorter current to the up-cast shaft and cut off the inner part of the mine, and the men beyond those doors were saved on account of the afterdamp not penetrating to the other workings? What I mean is that they tell both ways; they may separate and prevent the afterdamp from going further, but they may also have a deadly effect by driving the afterdamp of the explosion to the other workings?—It is rather awkward to couple the two things together in my mind. I realise the point which you are driving at; you are pointing to the circumstance that taking this plan there might, at some point or other, be a separation door, and that it might be advantageous that it should get blown away in the explosion. I realise that that is possible, but I can conceive of no explosion in which the fact of a door like that being blown away would be advantageous.

11203. It depends upon the position of it?—But these doors are at the shaft bottom, and simply have the effect of severing completely and of making the two workings practically two collieries; no one would for a moment argue that it might be advantageous that one pit 10 miles away should be coupled up to another—I am trying to put an extreme case.

11204. (*Mr. F. L. Davis.*) These doors are not on the main roads?—No, not in any way. They are never worked.

11205. We will say *this* is the main road, and the door would be going through *there* to connect with the other shaft (*describing*)?—Let me put the illustration in another way. Supposing, for instance, you had a pit at Brighton and a pit at Hastings; if an explosion happened at Brighton, it could by no possibility happen at Hastings, and it would not communicate with Hastings at all; but if it so happened that you had got the two mines at Hastings or the two mines at Brighton, then I want, if possible, to prevent an explosion which happen in the one affecting the other, and I do that in this case by these doors, or rather by these stoppings—that is all.

11206. What I want to make clear is this: we will take these two lines on this Plan as two main roads, one haulage road belonging to one pit and another haulage road belonging to another pit?—That is it.

11207. Your doors would go from one to the other The way of escape for the men, if there was an explosion would be a door *there* and a door *there* to get across from one to the other; is not that the idea?—The plain lines on this Plan show the roads in connection with the workings of an upper seam; the dotted lines show the roads in connection with the workings of a lower seam. Before these stoppings were put in, if anything happened here, supposing a boiler explosion occurred, it might have affected the ventilation going down into the lower seam, and might have made a difficulty there as well as in the upper seam. By putting stoppings around those two shafts, which are shown together in black, I prevent that happening—I practically insulate the workings of the one from the workings of the other. But inasmuch as, as a matter of convenience, I want to get sometimes from one seam to the other, I introduce through two of the stoppings these little valve doors, simply as a matter of occasional use; therefore I do not use the doors as roads through which ordinary traffic goes.

11208. (*Mr. Wm. Abraham.*) You make them specially for that purpose?—Yes; that I find it occasionally convenient to go from one to the other. In point of fact, I have some haulage ropes driving the one set of workings which are going down the shafts allocated to the other workings; I have a pipe of a few inches in diameter through the dam, and the rope runs through that pipe, so that *this* little door, which is the size of *that* fire-screen, is used by the men to get to the wheels which are in one pit, to enable me to work my haulage gear in the other. Now do I make myself clear?

(*Mr. F. L. Davis.*) Yes, I understand the position of it.

11209. (*Mr. Ratcliffe Ellis.*) I will not ask you anything about the character of the dust, but do you think that we know so much about this dust question and the method of dealing with it as to make it unnecessary to have any further inquiry into the subject, or do you think it would be desirable that there should be an inquiry, with proper arrangements made for making tests as to how far the dust could be prevented travelling by means of water, or how far it could be prevented travelling by removal? It has been suggested to the Commission that there should be some tests made on a large scale to ascertain the effect of dealing with the dust in certain ways. Do you think it is desirable to do that?—I can see no harm in it at all. I think the more we know about dust the better, speaking broadly.

11210. One word with regard to shot-firing: you fire shots, I understand, in the coal during the shift in the day?—Yes.

11211. You think it is quite safe to do that, and you have had no reason to suppose otherwise?—I have not.

11212. It is not necessary in your case to fire them between the shifts?—I am afraid I do not quite see how we could do it; I mean, it would be a very difficult thing to work out in practice.

11213. A shot-lighter is available, whenever the collier is ready during his shift, to go and fire his shot for him?—You see it works out in this way: men are working in the coal face, and they break down four or five yards with a shot, and then the loaders load it up; and then, perhaps, three or four hours after that they want some more breaking down, or else they would be stopped, and then the shot-firer comes and fires a shot and breaks it down.

11214. In your case it would be a loss of time if the shot, firing was done during the night or between shifts?—Yes, in the getting of coal.

11215. In the shot-firing and in the getting of coal, where the shot is fired in the coal in your colliery, it is fired by competent persons, and not by the collier, I suppose?—That is so; it is fired by the shot-firer.

11216. In those cases the shot-firer decides whether he shall fire it or not?—Yes.

11217. With reference to firing shots in roads, your view is that not only they should be fired by a competent person, but that he only should be allowed to fire them after he has been specially directed in each case by his superior officer?—Yes. I am averse to shots being fired in the main roads of a mine without the special permission of the manager of the colliery.

11218. If that could be carried out, and you could insure its being carried out, that the shots should either not be fired at all or should only be fired under very careful supervision, would that not very much minimise the danger from explosions of dust?—Yes, probably it would; but I think an effort is required to be made to move dust, and I think it would be wise to do it.

11219. Even if you could put the shot-firer under that very careful supervision, you still think it is necessary to do something in dealing with the dust?—I think it is very necessary to do it. We have to remember that we have occasionally underground boilers which might disturb dust if any failure occurred.

11220. How would that boiler question affect the question of dust?—I do not know; it is very difficult to say.

11221. (*Mr. Wm. Abraham.*) You mean a boiler explosion?—Yes.

11222. (*Sir Lindsay Wood.*) Would a boiler explosion affect the dust?—I should not like to say. It is not a very desirable thing to get a lot of dust blowing about owing to the fact of something going wrong with the boiler.

Digitized by Google

11223. (*Mr. F. L. Davis.*) The dust would be damped by the steam, would it not?—The two might not be together; it is difficult to say. Speaking broadly, I am in favour, as much as possible, of keeping down the dust; that is very strongly my feeling.

11223*a*. (*Mr. Enoch Edwards.*) It occurs to me that we may weary you with a repetition of the form of some of these questions, but up to now the theory put before us in dealing with the question of spread of explosion has been to deal with it by water, so that you must not be alarmed that the same form of question is put to you again. I have already asked you whether you have had experience in dry and dusty mines, and whether you consider yours dry and dusty?—The colliery I have been speaking about is dry, and I think it would be a very dusty mine if we had very open tubs or that kind of thing.

11224. It would not always follow that a mine is dusty in the sense in which we understand it because it is dry, would it?—My point is that I think it is possible to make a mine dustless, or fairly dustless, although it be dry. You see, this is my old paper of ten years ago, "How a Mine may be Dry but not Dusty." I have got a mine which is dry, but I think, on the whole, it is not dusty.

11225. What I am trying to lead up to is, having regard to your suggestion about cleaning up this dust, whether your experience in regard to these particular mines would have the same relative force in some of the very highly explosive mines which are very dusty. That is the way I put the question to you—that it is possible that you work seams of coal which are very dry, but that in their nature are not themselves dusty seams. You rather suggested that it would be dusty if it was dry. Now, I understand you to say that you have a seam which is not so dusty but is dry.

(*Mr. F. L. Davis.*) A colliery, not a seam, I think the witness said.

(*Mr. Enoch Edwards.*) A colliery which is not so dusty but yet is dry.

(*Witness.*) I believe that if we worked this particular colliery with open-ended wagons we should have a very dusty mine; but inasmuch as we work with close-ended wagons, we have not a very dusty mine. Still, the conditions are favourable for dust, and there would be the dust if we had the open-ended wagon.

11226. I think that would follow in every case, and that the members of the Commission will quite realize your suggestion that if you can keep the roads clear you are going to have a much better mine from the point of view of safety than people who allow roads to get covered with dust?—Yes.

11227. Would not the measure of dust flying about in the air in a mine depend upon the amount of small stuff you were sending out?—No, I do not think it does. Whether you have loaded the coal all together as it was got, large and small, or whether you have loaded it all by hand down to the size of *that* ink-pot, I do not think makes a great deal of difference.

11228. But if you take mines of varying degrees—that is to say, mines producing only about 40 per cent. of large coal, in which the small coal is very dry and dusty of itself, I put it to you that your large coal which you refer to would not yield the dust in transit or about the screens that this class of fuel will when tipped up in screens?—I do not think there is much difference.

11229. You think not?—I think not.

11230. In regard to the sections which you have shown us, that is rather where we want to feel at one with you, if possible. As to the general principle of clean roads and clearing the dust away, everybody who knows much about mines will agree with you that you reduce the risk if you can keep the place free from dust. The evidence given before us as to the watered roads is evidence in which there is clear demonstration that explosions have been stopped at the point where the roads have been damp or wet.—Yes.

11231. You have no experience of an explosion happening under the principle you have adopted at your colliery?—No.

11232. You have heard the question which the Chairman was putting to you about the travelling of an explosion?—Yes.

11233. The suggestion was that it was more likely to continue over that area which is dry but tolerably free from dust than it would do if the road was watered.—Yes.

11234. Do you agree with that suggestion?—I am not prepared to say that I do not agree. I think there is force in what his Lordship says, but I think it is met practically in this way; assuming that a very wet road is the best thing to stop an explosion extending, I think it is met by making the dry section somewhat longer.

(*Mr. Ratcliffe Ellis.*) Would it be necessary to make it longer where it is dry than it would be where it is dealt with by water?

11235. (*Mr. Enoch Edwards.*) Of course, I understand you are going on the assumption that the whole of your roadways are tolerably free from dust, on your principle, but that you have sections of 100 yards or 200 yards which are made absolutely free by preparing the sides and the floor?—Or that can be made absolutely free from dust.

11236. Yes, the suggestion which you put before us is that under these conditions, assuming there is some care exercised in filling the tubs, in regard to the class of tubs, it would be sufficient to check the progress of an explosion?—Yes.

11237. Of course, you are aware that there are many collieries in the country where they use close tubs in dusty mines, and have been doing so for years.—Yes.

11238. Your suggestion is that if these tubs are used, and ordinary care is taken to keep the roads clear of dust, this specially prepared portion would be sufficient to check the progress of an explosion?—I think so.

11239. It might be possible, in the absence of any moisture at all in a very dry place, for an explosion to carry over that 100 yards or 200 yards. You have not put it to any test?—No.

11240. In your judgment, if there is nothing to feed it it will not travel?—I think so.

11241. (*Mr. F. L. Davis.*) Practically all the questions I was going to put to you have been asked already. On this last point, which Mr. Edwards was asking you about, I am not sure that Mr. Ellis included this in his question: do you think it would be advisable for experiments to be made with dry zones such as you have in your collieries, in the same way that experiments have been made with wet zones?—I think it would be a very good thing to do. ✓

11242. I think you suggested in answer to Mr. Ellis that this question of coal dust altogether is a very important one, and that it would be a very great help to all people engaged in mining if further experiments were made generally—I suppose by the Government, or by people selected by the Government—with regard to these different kinds of dusts, the dusts which are inflammable and the dusts which are not. At the same time I would suggest whether it would be not a very good thing to experiment with this dry zone at the same time?—I think it would.

11243. Do these protected areas which are marked on your plan represent the actual number of yards that you have at the present in your collieries?—Yes.

11244. That is to say, 2,000 yards altogether, I think?—I think it is 1,500 yards.

11245. There is one of 800 yards, and there are four of 300 yards?—Yes, that is it. *This* section is in a cross measures heading.

11246. I mean this plan represents the actual state of affairs?—Yes, it does more or less.

11247. I should like to know how many yards of this prepared road you really have?—This is about what it really is: I do not say that the whole of this is made smooth and done quite in the way that I should like it to be done, assuming one had a free hand in the matter: I am working up to a direction of things in which if everybody else was compelled to do something of the same sort I should do *that*.

11248. I can see that you say that even your system might be improved at your own place?—Yes—I have pounds, shillings and pence to consider in these matters. I think I need not enlarge upon that—you see what is in my mind.

11249. In this mine, a plan of which you have shown us, what is the output?—About 1,200 tons per day: it is a very old mine now, and I am sorry to say it is very nearly worked out.

11250. Is this same system that you have at the Babbington Colliery Company's pit adopted in the other collieries in which you are interested?—In one of the Warwickshire pits I have had some short sections prepared in that way. I have not yet seen them myself. It is a mine which is rather apt to be dusty, and I have had some short sections done, and the cost of doing it in that way came out, as the Manager has done it, to

Digitized by Google

Mr. George Fowler. 24 Jan. 1907.

rather a higher figure than I told you before: I think myself he has done it rather needlessly well and expensively, but that is what he has worked upon—the plan of smoothing the roads, and of setting roof bars and flooring in between so as to make the surface as smooth as possible; and he has brought it to something like 8s. or 10s. per yard as the cost.

11251. May I take it that in the other two collieries which you are interested in, and which you have mentioned, there is practically no watering?—That is so.

11252. Whatever is done is done more on these lines, to try and keep the mine free from dust?—Yes.

11253. And practically without watering?—Yes.

11254. Do you know any of the mines in Wales?—I do not.

11255. In answer to some questions put to you you stated that you think it advisable to have the screens about 100 yards, or some distance from the pit top. That is, I may say, practically impossible in Wales. In any new mines you might have some regulation of that kind, but owing to the very narrow valleys, and the position in which the pits are sunk, practically without exception all the tipping in Wales is done close to the pit.—I think a suggestion by Sir Lindsay Wood would very much meet the case, namely, taking a boxing up to the level of the shaft and getting the air in at that point above the screens.

11256-8. I think that might apply in a fairly open country, but our valleys are so extremely narrow that you get varying winds, and you get eddies downwards: it might help you when the wind is in a certain direction, or when the atmosphere is in a certain condition, so that the dust would go up in the air and be free; but at other times you would have eddies, I am afraid, because the valleys are so narrow, and they turn at very sharp angles, so that I do not think it would work. But I do not think there would be much danger from dust going down the shafts, because our shafts are very nearly always wet. It would be practically impossible in Wales to have our screens at that distance from the pits?—No doubt that would be so.

With regard to the clearing of the prepared roads I should have mentioned that in many parts we use more or less whitewash on the sides so as to make it obvious and clear, and so as to make the surface more easy to see, as to whether there is dust on it or not. There is a little machine used for whitewashing now which pumps the whitewash or throws it on with a spray, and makes whitewashing a very simple and cheap matter. That makes the side of the road very easily seen, and it is clean, and that helps the process of bringing the surface up to a sweepable condition.

11259. (*Dr. Haldane.*) With regard to cleaning the mine from dust in zones as you propose, I should like to put to you this objection, which applies equally to watering in zones: supposing there were from any cause a dust explosion between the dust-free zones, as might happen on an intake road, you would have the afterdamp produced by the explosion carried along into the working face, would you not?—Yes.

11260. And that would leave some element of risk?—Yes, I think it would.

11261. Therefore it would be necessary, if that plan were adopted, to combine it with pretty strict Rules for instance as to blasting on a main road, which would be the chief, or almost the only possible source of an explosion on a main intake road?—Yes, I think so. I think we cannot be too careful about blasting on the main roads.

11262. You would propose to put the dustless zones between the face and the main road I suppose in every case?—Yes, between the faces—cut the main road into sections really.

11263. This plan, for instance, is not of course an ideal plan, but is an actual plan of what has been done. But I put to you this case: supposing a firedamp explosion of some sort started at the face, and supposing the dust were very inflammable, it would spread back along this intake road, would it not—that, I suppose, is a haulage road (*pointing on Plan*)?—That outside road is a travelling road.

11264. Then my objection would not apply: I was assuming that *this* was used as a haulage road?—It has been, but at the present moment it is a travelling road.

11265. If it were a haulage road the explosion could spread back in this way and come round here (*indicating on Plan*)?—Yes, I daresay it would not be a bad thing to put a dustless zone on that: in policy it would be a good thing to do. I think the plan of cutting up a mine in sections by dustless zones is capable of extension, and I think it is a good thing to do.

11266. That is the plan: you would isolate the main roads from each district?—Yes, I think so.

11267. And also cut up the main roads themselves into dustless zones?—I think so.

11268. The vacuum cleaner plan to which you have referred has not, I believe, been tried actually in the main roads of a mine, has it?—No, it has not been tried, but it is such an extremely easy method, and one sees from its application to domestic work that it is so extremely easy to apply, that I see no difficulty about it in mining. It seems to me it would reach behind and above timber in a way which nothing else possibly could: so that I think really it would be a most efficient machine. If you adopt a plan of squirting water at side timbers, you can hardly get it at the back of the timbers, and supposing you have a lot of timber packed up above a heavy fall you may have five or six yards of loose timber above you, and you cannot inject water up into that in any useful manner; but you could get the end of a vacuum cleaner pipe pushed right up and so draw a lot of the dust away.

11268A. I am bound to say I should have thought it was almost easier to get the water up there than to get the end of the vacuum cleaner pipe there; but that is a matter for practical experiment, I think?—I think there is something in the idea of the vacuum cleaner. I saw the suggestion was made, and I think it is worth doing—anything rather than watering is what is in my mind.

11269. Now, to come to the objections to watering, of course you are aware that the watering plan has been tried on a very large scale, particularly in Westphalia, and of course also in parts of England?—Yes.

11270. And that no particular trouble seems to have arisen from it, at any rate in Westphalia?—They have had ankylostomiasis pretty much out there, have they not?

11271. Of course they deny, or a good many of them deny, that that had anything to do with the watering; at any rate it was there with the water, and I rather agree with you that the watering had a good deal to do with it?—At any rate, the mines in England are free from it, and I think that whilst the mines are dry we shall not suffer from it; but once we begin watering our mines we may get it, and it is such a terrible thing that I dread the possibility of getting it.

11272. I think watering at the face might certainly increase the risk of it. Supposing you confined the water to the main haulage roads—the intake roads particularly—there is no reason why they should be polluted by the excreta of men infected with ankylostomiasis?—They very often are. It is very difficult to be quite sure that you do not get anything of that sort. I remember seeing a reference to the matter (I do no know where it was) with regard to a large tunnel which has been driven through the Alps by the Italian workmen, where they had a very complete arrangement for washing the men—a sort of public place, on the German plan of washing them; those men's clothes were hung up in the drying room; they had this disease amongst them rather badly owing to the fact of their clothes touching; one man had the disease and his clothes touched someone else's, and the disease was spread about in the drying chamber.

11273. I do not think there was any evidence that it spread to the drying chamber; I think you must be referring to the St. Gothard tunnel where they had it very badly. There the ground was polluted wholesale by the men, and they did not know anything about ankylostomiasis. It was during the work of that tunnel that the disease was really to a large extent investigated, and that it was realised that there was such a disease. But in the case of the Simplon tunnel they took precautions, and there was no trouble at all?—They had it at one mine in Cornwall, I think, did they not?

11274. Yes, at one mine in Cornwall it was very bad; that was where I first came across it in England. But that was very much polluted underground. You are aware that they got rid of the disease in Germany in spite of the water; they have kept their watering and have got rid of their worms?—I was not aware of that.

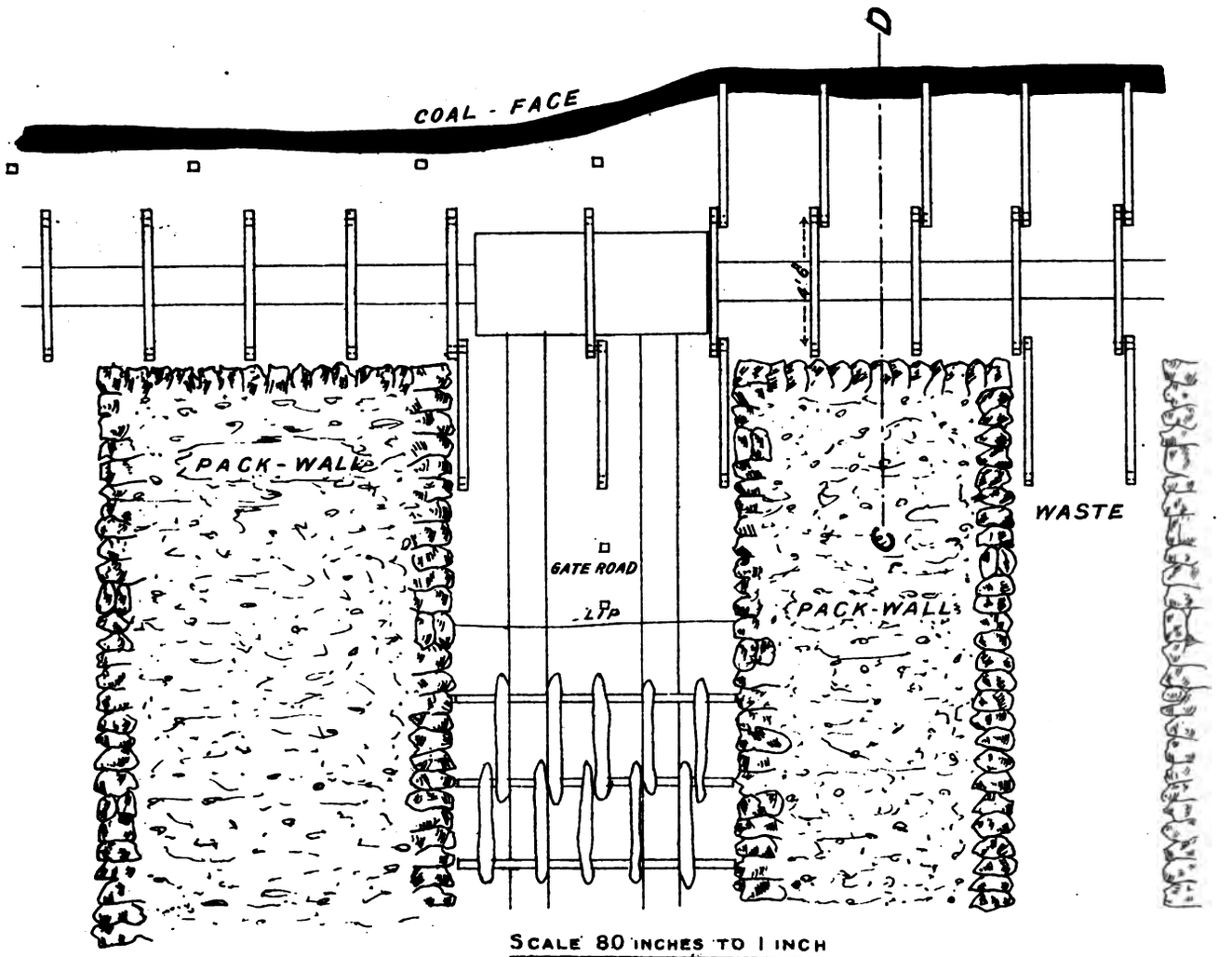
11275. That is so now, but they have of course had a great deal of trouble and expense in doing so. Do you think that the form of close tub which you recommend, could be used in all sorts of coal mines?—I know of no reason why it should not be: if you want something which will convey coal from the face to the pit, I do not see why it should not be. It might make some difference in arrangement of cages, tips, and so forth, which would

Digitized by Google

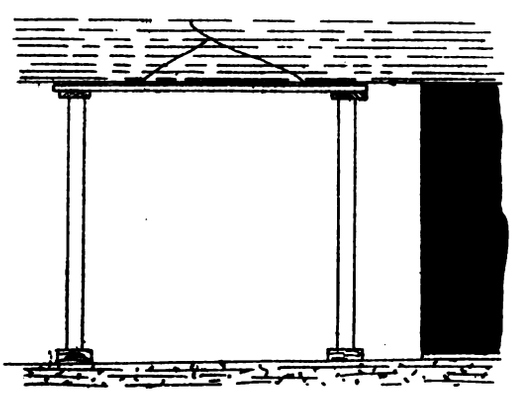
Digitized by Google

ROYAL COMMISSION ON MINES.

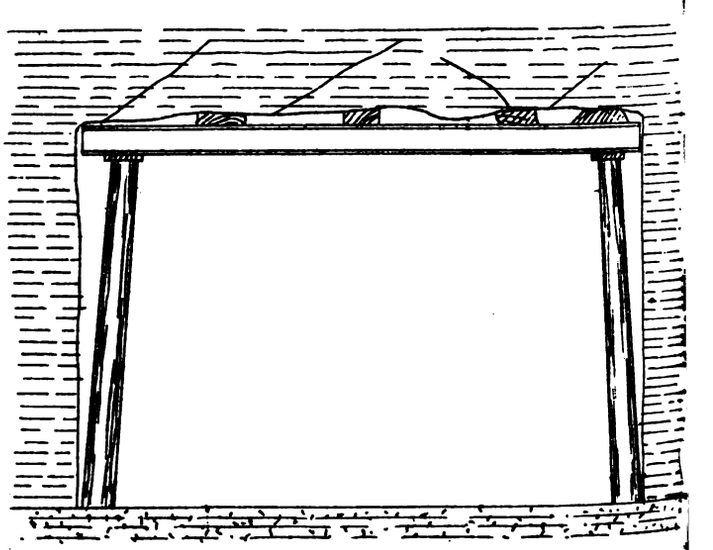
SYSTEMATIC TIMBERING AT THE BABBINGTON COLLERIES.



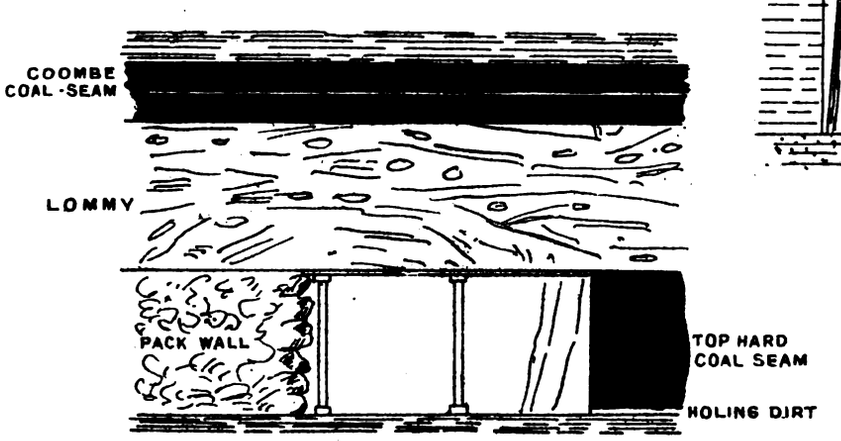
SCALE 80 INCHES TO 1 INCH



SCALE 40 INCHES TO 1 INCH



SCALE 40 INCHES TO 1 INCH



CROSS SECTION THROUGH LINE C.D.

SCALE 80 INCHES TO 1 INCH

Digitized by Google

Weller & Graham, Ltd Litho London

have to be considered and which would produce some difficulty: but in the long-run I do not see why close tubs should not be used in bringing coal from the face to the pit bottom.

11276. Supposing the plan which you recommend were adopted and were sanctioned by law or in any way made compulsory by law as an alternative perhaps to watering, it would be necessary also to make regulations with regard to the tubs, would it not?—I take it that probably it would: yes, I think it would.

11277. It would probably be impossible to carry out this system properly without having close tubs, would it not?—I think I should put it in this way; some persons possibly might object to legislation taking the line of dictating quite definitely that you must make a close tub, or that you must do this, or that: some owners of mines might very reasonably say "We do not like it": but if you take the line of saying "You must not have dust in the roads" probably owners of mines would think "We had better close the ends and sides of our tubs so that dust cannot be scattered about."

11278. Yes, all I mean is that it would in practice come to using close tubs?—I think it would. If the legislature took the line that it must be essential that coal should be conveyed from the face to the pit bottom in wagons which did not scatter the dust about, then I think the owners of mines would close in the ends and sides of their tubs—and I do not think they would get themselves into bankruptcy by doing so.

11279. It would be a very large expense, would it not?—It would be no doubt some expense. I am not working in a district where an open-sided wagon, such as one of the Commissioners mentioned, is in work, and I would rather not say so much from that point of view, because I am not interested in the matter. But I know that in the parts of the country which I am interested in myself I have found no difficulty in using a close-sided pit wagon. Is that not an answer I may fairly give?

11280. Yes, I think so.

(*Mr. Enoch Edwards.*) Practically all the mines in the Midlands have close wagons now?—A good many have quite an open end, and it is the open end which I think requires abandoning. I think the partly boarded-in wagon practically meets the difficulty. But I have seen open ends in work: as I told you in my evidence before, I used them myself and closed them up, and I think other people would do the same if they realised the fact that it was the coal falling in the roads that made the difficulty.

11281. (*Dr. Haldane.*) The workings referred to in your evidence are all longwall workings, I think?—Yes.

11282. Many of the branch roads in pillar and stall workings are very dusty by reason of coal falling from the sides, are they not?—I dare say there may be some difficulty from that in workings conducted in that manner. I cannot express any strong opinion upon that point, because I have no mines working by pillar and stall. I am speaking of workings by longwall. Longwall is, I think, so very general now that I should imagine perhaps three-fourths of the mines in the country have longwall workings: the Midland collieries and all the Welsh collieries and many of the Lancashire collieries work longwall, and I should think quite three-fourths of the country have got longwall workings.

11283. I think that is an objection which would perhaps occur in some districts, for instance, North Staffordshire, where the pillar and stall system is extensively used?—No doubt that is so.

11284. (*Mr. Enoch Edwards.*) The gradients are rather against the longwall in North Staffordshire, although longwall is more extensive?—In some of the Warwickshire mines hills are driven down into the coal, and the faces are brought back through these roads. I do not think, although their roads are in the coal, that there would be much difficulty in keeping them fairly clean from dust if they wished. What occurs to me is that, broadly speaking, colliery managers have never put it to themselves to try and remove the dust from the sides. I have seen roads which I thought could be cleared with very little trouble if people would like to clear them.

11285. (*Dr. Haldane.*) With regard to the kind of coal in the mines which you refer to, you have I think already expressed the opinion that it does naturally form a good deal of dust: when I say "naturally," I mean if no means are taken to prevent the formation of dust: it is a fairly dusty coal?—Do you mean in relation to this particular mine?

11286. Yes?—I say that I think there would be plenty of dust in the roads in this colliery if we had the wagons which we have just been speaking about. As a matter of fact, I know that we had a great deal of dust until we closed the ends, and I think the closing of the ends of the tubs had the effect of checking the amount of dust made. I think the faces are fairly dusty.

11287. You do not think that the objection might be raised that that particular kind of coal is not liable to form dust? There is no doubt a great difference between different kinds of coal?—I can quite believe that the objection might be made, but I do not think there is much in it. That some coals are more dusty than others, of course. I admit: the soft coals make more dust than the coals with hard bands: but I do not think there is much in it myself from that point of view.

11288. With regard to the timber, you expressed the fear that watering would rot the timber; but is there not a good deal of evidence to show that if the timber is kept wet constantly it stands extremely well? Take, for instance, timber in Cornish mines which are always wet; it seems to last for a very long time?—There may be some salt in the water in Cornwall. I do not know. I have no knowledge of Cornish mining and I cannot say. All I know is that in Nottinghamshire we have some wet roads where the timber very soon forms fungus and that the timber does not last more than a year or two.

11289. Is that timber kept constantly wet, or is it alternately wet and dry?—It is constantly wet in some shallow workings where surface water gets in and where the ground is wet and moist. There is plenty of air moving by the place also, and there the timber soon gets mouldy. Some years ago I tried the effect of whitewashing timber to see whether that would prevent mould attacking it, because we were rather subject to it in some of our workings. It did to a little extent preserve it, although you cannot very well whitewash the back of the timber; I thought the whitewash or limewash did it some good. All other things being equal, the drier the road the longer the timber will last. I think I cannot put it better than that.

(*Dr. Haldane.*) In Germany we watched for signs of timber going rapidly, and we asked German managers whether the timber did go rapidly with the watering, but they did not seem to complain of it at all.

11290. (*Chairman.*) I have in my hand a reprint of a paper which you read before the Institution of Mining Engineers at a general meeting at Nottingham on April 13th, 1901, on systematic timbering at Babbington Colliery. We shall be very glad to know what your system is and the results of it, if you will kindly tell the Commission?—First of all I wanted the timbering to be set at regular distances and not somewhat haphazard, and we began to pitch the props in the face at a distance of about 3 ft. 6 in.; we found that was rather closer than was convenient and we widened the distance to 4 ft. Props are now set along the face at intervals of 4 ft. Whether they are presumably wanted or not, we made the rule that the props should be set systematically at 4 ft. I think that is all I can say as to systematic timbering—that we pitch the props regularly at a certain distance. These mines are virtually wholly propped with steel and barred with steel. We have a very large number of these steel props, and the mine is propped and barred with steel, and the arrangement works exceedingly well from the point of view of keeping up the roof. Those props are set 4 ft. apart, and where the roof is bad and where we have this soft roof we bar between the props.*

11291. (*Mr. F. L. Davis.*) What is the horizontal: is that wood or steel?—That is a steel bar set in the wood in that way. (*Describing.*) We use steel girders in the roadways and we use steel props in the faces at *these* points, and we use a flat steel bar in the faces where we have this weak rock. Sometimes this coal comes down on *this* or is quite close to it. (*Pointing on drawing.*) When that happens, we do not want to use these flat bars, but when *this* flies away, the surface is extremely weak, and then we have to bar between prop and prop. (*Indicating on drawing.*) But the main point of the system lies in the fact that we always put these props up whether the roof looks good or whether it does not.

11292. And those are steel?—Those are steel; the whole mine is worked with steel. The seam varies from something like 6 ft. to 3 ft. 6 in. in height, and it means that we have to have a rather large stock of the steel props of different lengths. In point of keeping the roof up it works extremely well; in point of cost I do not think

* *See* Plate IX.

Digitized by Google

Mr. George Fowler.

24 Jan. 1907.

there is very much in it, except that it carries the roof better.

11293. You use them over and over again?—We use them over and over again, we keep drawing them back and moving them forward. In this seam we do not hole at all—the coal slides off. Generally speaking, there is about a foot of soft stuff at the top of the seam; this is got away and it sets the coal at liberty and we keep driving it off with bars. When it is only a narrow width they set a temporary prop like that. (*Pointing on drawing.*) When they get a full width they either set a prop in the wall itself or set a prop until they turn over, that is to say, bring the rails away from *here* and set them there. (*Pointing.*) Then *this* is dispensed with and the packs are brought forward. When this "lommy" is about 3 ft. thick, it is a very bad roof and very troublesome to keep up, and the barring keeps it up very well. The plan of pitching the props at regular distances is the thing which I think has stood well in our case. The whole mine is barred with steel and propped with steel.

11294. How long have you been generally using that steel?—It must be something like 15 years.

11295. And you are satisfied, I presume, that it is cheaper than timber?—Yes, I think on the whole it is cheaper. It works very well. We have got £30,000 worth of steel in the place quite, if not more.

11296. Are you able to draw them all out?—Yes.

11297. It is quite an exception if you do not get them out, I suppose?—Yes. It is just conceivable that something might make it desirable to move the timber and so forth; then I should run a little wood timber in if I knew it had to be left. If I knew that I should not recover it, I would not use the steel; but the men like the steel and I like the steel.

11298. What is the effect of a very severe squeeze. I mean the prop does not get bent and it stands in its place—would it fall either side of it?—I think the prop bends; you see there is a little cushion of wood. (*Pointing to drawing.*) On the average they stand setting about three times. I use hard wood; these are seasoned on the pit bank at the top so as to make them tough, and they stand three or four times. Since we substituted steel for timber the roof has substantially improved.

11299. (*Mr. Ratcliffe Ellis.*) Have you made any comparison between the accidents which happened from falls of roof before you adopted that system and since?—I am afraid we have not worked that out. We have got the figures of accidents which occurred since we introduced it. Certainly we have had considerably less accidents in the stalls, but I have not the exact figures here. This is something which bears upon it. From 1880 to 1889, when we were not using the timber quite so systematically, our death-rate was 0·68 per 1,000,000 tons; then, from 1890 to 1899, it was 0·51.

11300. Have you similar returns in respect of the non-fatal accidents?—I am afraid I have not: these are simply the fatal accidents.

11301. They would probably be proportionately less?—They would be less also.

11302. Is it your experience that, where you adopt systematic timbering, it at all goes to lessen the responsibility of the persons who are responsible for the timbering? It is suggested that in some cases where it is prescribed for a man where he must put his timber, he does not trouble at all himself to look whether it is necessary to put it anywhere else, and that he puts it there and considers it is sufficient, and that in that case, by lessening the responsibility of the man, it is prejudicial to safety?—I cannot say that I think that at all. The best answer to that is that in this case we do set constantly props which are constantly being moved, and those props are set without any difficulty by the men. I think systematic timbering is quite in favour of safety and of economical working of the pit.

11303. Can you suggest any reason why, since the special rules were established for timbering, the number of accidents has increased from that source?—Is that a fact?

11304. Yes, that is so; they have increased.—I cannot understand that.

11305. (*Chairman.*) You employ special men, do you?—No.

(*Mr. Ratcliffe Ellis.*) In that district the men set the timber themselves.

11306. (*Chairman.*) Do you think it is a good plan to let the men set the timber themselves, or do you think that some official like the fireman should be entrusted to do it?—No, I think we could not very well work without the men setting it themselves; they may want a timber moved or set immediately, or a quarter-of-an-hour hence. I think it would come to this, that we should have to have one man standing by looking on while another man worked.

11307. I was thinking that it might be somebody's duty to go round the working places and just look at the timbers?—So it is, because we have the deputies to do that.

11308. Then would the deputy suggest to the men that they ought to put up an additional prop, for instance?—It is quite likely. I have men brought before me, not infrequently, on Fridays, which happens to be my day there, for neglecting to set timber; but the setting of the timber is the responsible work of the stallman to whom the working place is let, and I should be very sorry indeed to see anything done to lessen the responsibility of the stallman for doing that.

11309. (*Dr. Haldane.*) But he is only responsible for carrying out the rules which you have laid down as to how the timber should be set?—Yes.

11310. (*Chairman.*) Supposing under the circumstances it is clearly desirable to set another prop, then would he be responsible or not? Supposing you had the prop set, and according to your rules it clearly appeared from the circumstances that another prop ought to have been set, who would you say was responsible for doing that?—The stallman, certainly.

11311. Not the fireman who goes round?—No.

11312. (*Mr. Ratcliffe Ellis.*) I think you have another rule besides the special timbering rules, which were established a few years ago, obliging the stallman to set such timber as is necessary to keep himself safe?—That is the rule.

11313. Then the new timbering rules were in addition to that, and they provided that the management should direct as to the distance from the face at which the timber should be set?—Yes.

11314. But they did not relieve the worker in the stall from the obligation to see that he had a sufficient amount of timber set to keep himself safe?—That is so.

11315. It has been suggested that the rise in the number of accidents from falls has happened because the managers have prescribed too great a distance from the face at which timber should be set?—Yes, I understand what you mean.

11316. (*Chairman.*) Is it not that the bars must come within 2 ft. of the working face?

(*Mr. Ratcliffe Ellis.*) I think they have prescribed a greater distance than that, and it is suggested by the inspectors that they have prescribed too great a distance, and that the men, having that distance prescribed, have not thought it necessary to put the timber any nearer the face.

(*Witness.*) I can conceive that that may be possible, and my point really was this. I think in the interests both of men and employer it is desirable to get your timber set as closely as you can, subject to providing room in which to work. The thing that is most desirable for the man who wants to make money and for the owner who wants to conduct his place properly, and so forth, is to keep the roof up and prevent falls. Therefore, it is desirable to set timber rather too thick than too thin. I began, when I adopted this plan of systematic timbering, to have the props set at a distance of 3 ft. 6, because I thought that would keep up the roof better. It was found in practice to be a little awkward for the men to get about with timbers at 3 ft. 6, and I was asked if I saw any objection to increasing the width to 4 ft., and, after some discussion, I consented to that modification. It has not produced any detrimental results, and I think it works very well. I am in favour of setting timber closely together. I think if a 4 ft. rule for timbers along the face was adopted in roofs like we have there, which are somewhat weak, clod roofs, that would work out all right, and the figures would come out satisfactorily as to the number of accidents. I should be disposed to agree with your suggestion that if the systematic timbering has resulted in accidents increasing rather than being lessened, it is because too great a width has been fixed.

11317. You would not think that it resulted from the men being relieved from the responsibility and neglecting to do more than is prescribed for them?—I do not think so. We have never found it so with our men, and I have never heard of our men arguing that that was the intention. When men have come before me for neglect of timber,

Digitized by Google

which they do occasionally, I have never heard that pleaded.

11318. (*Chairman.*) It seems to me that these statistics which you have handed in are not worth a very great deal, because they deal with such a very few fatal cases; the number of persons injured in nine years, from 1880 to 1889, was only three, and from 1890 to 1899 only three. One less would make an enormous difference to the percentage in such a small number as that. I should have thought it would have been better to have put in all the accidents whether they were fatal or not, and then the results no doubt would have been more?—I can get those figures worked out, no doubt.

11319. Probably there were a good many accidents, which did not end fatally?—Yes.

11320. (*Mr. Wm. Abraham.*) Have you noticed any different results where you are using steel props, between using them under a strong top and under a weak top? With the steel bars, of course, the tendency is not to break through the soft top; have you noticed that?—I cannot say that I have; I would not like to say that I think steel props are desirable or advisable in every case, but I think they might be used a great deal more than they are, and I think they are very distinctly in favour of the safety of the mine.

11321. Would you use them where there is a weak top?—Well, we are doing so here. But with a very bad top, in which there are falls occurring very often, probably it might not be possible to use them.

11322. That is what I had in my mind?—Certainly, I should not desire to say that I thought they were always applicable, or ought always to be used.

11323. They would not be best in all cases?—Not the best in all cases.

11324. (*Mr. Ratcliffe Ellis.*) Have you anything of this sort, by carrying a bar like that (*sketching*), near to the face, so that you might have the prop further away from the face, and still have the roof supported nearer the face by a bar?—I understand what you mean—making that a base for a T-shaped thing.

11325. Yes.—We may do it to some extent. We slip the bars into the face; they cut a notch into the face—they have become very clever with it—and they slip it into the face. For instance, take that prop (*pointing to drawing*); that is set there with the intention of moving it again; if that place was very bad, the men would not bar into the face, but they would set it like that. (*Describing.*) But when they get width enough, they will set a prop along the face side, and then they will pull the rails out of that place and turn over, as they call it.

11326-7. Do you resort in some places to the system of putting a bar under the coal between these parts—because *that* would give way when *this* would not (*pointing on Drawing*)?—They have got this bar notched into the coal itself *there*.

11328. (*Chairman.*) I have been looking at these samples of coal dust which you have produced, and I am rather surprised to find what an enormous difference there is between the size of the coal dust that you break up on the floor of the main road, and the coal dust which you call main-road dust, which, I suppose, is coal taken from the sides and top of the main road?—Yes.

11329. It seems to me that the dust from the floor of the main road, to a great extent, would not be inflammable, because it is too big?—The main roads generally get down into the bind and shales below the coal, and the dust is caused by the grinding up by men's feet.

11330. The sample from the main road floor seems to be quite big, and a great deal of that would be hardly inflammable, I should think?—No; that is what you find on the main road floor.

11331. Is there any other statement you would like to make to the Commission?—I think not.

EIGHTEENTH DAY.

Wednesday, 6th February, 1907.

PRESENT:

Lord Monkswell (*Chairman*).

Sir Lindsay Wood, Bart.
H. H. S. Cunynghame, Esq., C.B.
Wm. Abraham, Esq., M.P. (Rhondda).
F. L. Davis, Esq.
Enoch Edwards, Esq., M.P.
Thomas Ratcliffe Ellis, Esq.
John Scott Haldane, Esq., F.R.S.
Robert Smillie, Esq.
S. W. Harris, Esq. (*Secretary*).

Mr. George Henry Hollingworth called and examined.

Statement of Witness:—

11331a. (1) I am of opinion that the universal watering of British Mines is impracticable as a commercial proposition. The expense of this work would be prohibitive.

(2) Really effective watering would, in addition to the cost of application, add very materially to the cost of working, it would increase the lifting of the floor of the coal seams and the pushing of the sides, and increase the tendency to breakdown of the roof and sides as well as causing the premature decay of the timber.

(3) The risk of accident from falls of roof and during repairs would be very much greater. Repairs to wet roof and sides and handling wet timber are very dangerous operations, and I have always taken special precautions in these circumstances. So far as I am able to form an opinion I think that the increased number of accidents from falls of roof and sides, if all were well watered, would more than counterbalance the possible lessened number of accidents by freedom from the extension of coal explosions. Under the present system of using permitted explosives the danger from explosions of gas and coal dust has become very much less; indeed in Lancashire the fatalities are very few. I am convinced that if the whole of the roads were watered the total number of accidents would increase.

(4) There would also be a tendency, in my opinion, to an increase of the number of sufferers from rheumatism

Digitized by Google

Mr. G. H. Hollingworth.

6 Feb. 1907.

and chest affections and colds, &c., in cases where roads were saturated with water, and this should be considered. In very hot mines, dry heat is much less oppressive than moist.

(5) I have generally looked more to the removal of dust where it accumulates than to watering, and have always got the natural mine water to flow in a defined channel as soon as possible for the convenience and safety of working, and to prevent the lifting of the floor and the tendency of the props to push out of position, which is very noticeable.

(6) The margin of profit in colliery working is very small in the great bulk of mines, and the added expense which would be caused by complete watering would necessitate the closing of many dry and dusty mines unless the selling price of the coal was substantially increased. Such mines might be exempted from the operation of the enactment, but such exemptions must be numerous, especially in the case of existing mines worked at long distances from the pit. It appears more feasible to deal with this question by increased precautions with respect to shot-firing in dusty haulage roads, but in such cases regard should be had to the quality of the dust, whether explosive or not; and the regulations that such roads should be completely watered in the vicinity of the shot should be cautiously applied. In dangerous cases also it might be made compulsory that the number of men down the pit and otherwise engaged than in shot-firing should be limited.

(7) So far as I can ascertain, knowledge of the condition of the coal and other dust explosions is not great, and I think that before further serious and expensive regulations are promulgated an effort should be made to obtain, by experiment or otherwise, full information, so that the regulations may be directed to the more dangerous conditions and the more drastic regulations made for very dangerous mines.

What kinds of dust are specially explosive, and what kinds are not explosive under mining conditions?

How much watering is required to prevent the extension of explosions? Quantity to apply? Length of wet zone?

How affected by temperature and moisture of atmosphere?

Effect of temperature of explosion of shot.

Effect of velocity of air-current.

Effect of mixtures of mine gases, dust, &c.

Establishment of a standard of dryness or otherwise.

Establishment of a standard of sufficiency of watering.

Whether an explosive could be selected which would be specially safe with coal dust, even if explosive, its use would probably be less costly than watering?

(8) If it were shown by such experiments that watering the roadways or the entire removal of the dust were necessary to avoid the extension of explosions, then further experiments are required before the length of zones of wetness can be fixed. If watering is essential, the zone system is preferable to general watering and appears likely to be effective in stopping the extension of explosions without increasing so much the liability to accidents of other kinds in the roadways.

(9) If it could be shown that a dustless zone of a reasonable length though dry would prevent the extension of a dust explosion, I should be much in favour of that method as not introducing other complications; at the same time it would be an expensive matter to construct lined roads if required of considerable length; and this also applies if watering of such lengths of roads is also necessary.

(10) So far as I have observed, fine coal dust, which I take it is the most explosive, is seldom found anywhere except in haulage roads, and more particularly where such roads are also travelling roads. The principal source of this dust is by escaping from tubs.

(11) The accumulation of coal dust in such roads may be largely prevented by improving the wagons, spraying the journeys, which would be expensive in most cases, and by arranging the screens at a distance from the downcast pit and placing them in a direction suitable to the prevailing winds (say N.E. of the pit) by collecting the dust in the screens and perhaps by covering the tubs, but I consider that the regular cleaning of the haulage roads is the most useful and generally applicable remedy.

11332. (*Chairman.*) You are a mining engineer with upwards of 30 years' experience in colliery management?—Yes.

11333. Would you give the Commission an idea as to where your experience has been gathered—in what part of the country?—More particularly in the Manchester District, but it includes North Wales, Yorkshire, and so on.

11334. How long have you been a colliery manager?—Since 1874.

11335. You have been a colliery manager since then—not sub-manager?—I took my certificate out in 1874.

11336. You are a Fellow of the Geological Society, a Member of the Council of the Institution of Mining Engineers. Past-President of the Manchester Geological and Mining Society, and Past-President of the National Association of Colliery Managers?—Yes.

11337. First of all you express the opinion that universal watering of British mines is impracticable as a commercial proposition owing to expense?—Partly owing to expense, and partly, of course, owing to considerations of safety.

11338. But your first proposition apparently is as regards the expense?—Yes.

11339. Dealing for the moment simply with the question of expense, what has led you to come to that conclusion? Have you made exhaustive enquiries?—That is simply the result of my general experience. Where you have wet mines as a rule the expenses of repairs of the roads are very much greater than the expenses in dry mines.

11340. Do you mean to say that in all your experience of mines in various parts of the country, you have never come across a case in which a mine might be thoroughly watered with advantage, and in which the expense would not be prohibitive?—I only know of one mine where it would do very little harm.

11341. With regard to all the other mines, how many other mines are you intimately acquainted with?—50 or 100 mines.

11342. You say that out of those 50 or 100 mines you only know one where a universal system of watering could be carried out so extensively as to make the expense reasonable, so to speak?—Yes. When I use the word "mine" I do not mean "colliery": I am speaking of a mine with certain physical characteristics.

11343. But we are now dealing with collieries?—Yes, but I mean to say that almost all other mines would take harm from watering. The particular one I refer to, owing to its characteristics, that is to say the rock roof and rock floors, would take no harm.

11344. Therefore you would say that where you had a rock roof and a rock floor it would be advisable probably to have a systematic system of watering all over?—I would not say it would be advisable, but it would not do the same harm to the roadways.

11345. You have only had experience of one mine at which, in your judgment, the conditions are such that universal watering could be carried out at no very great expense?—Yes—that is to say at simply the cost of the watering.

(*Mr. Ratcliffe Ellis.*) Perhaps the expression "seam of coal" would be more suitable in that context.

11346. (*Chairman*) Only one seam of coal?—Yes, only one seam of coal.

11347. Then you go on to give certain reasons why effective watering would add to the cost of working over and above the cost of application?—Yes.

11348. You say that it would increase the lifting of the floors of the coal seams; and of course we have had evidence to that effect already. It would do so very often, but would that always be so?—I have given you the one instance in which I do not think it would be.

11349. That is about the only instance?—That is the only instance.

11350. In every other case your experience teaches you that what you call effective watering—that I suppose would mean thorough watering all over?—Yes, thorough watering all over.

11351. Would increase the lifting of the floor?—Yes, it does so, and also the pushing of the sides.

11352. And would increase the tendency to breakdown of the roof and sides, as well as causing the premature decay of the timber?—Yes.

11353. All those things, you say, would result from an

Digitized by Google

effective universal system of watering in every mine that you know of, with the exception of the one coal seam you have mentioned ?—Yes.

11354. With regard to the risk of accidents, you say that the risk of accidents from falls of roof and during repairs would be very much greater ?—Yes.

11355. You consider that repairs to wet roof and sides and handling wet timber are very dangerous operations ?—Yes, much more so than in dry seams.

11356. In what way would the danger arise ?—You never can tell where the stuff will come or how it will come ; you lose the adhesion and the natural friction of the dry strata, and you get a polished surface on which everything can slide, and when you once set it in motion you never can tell where the movement will stop.

11357. Everything is much more slippery owing to the state of the workings than dry timber would be ?—Yes.

11358. Do you express the opinion that the increased number of accidents from falls of roof and sides would more than counterbalance the possible lessened number of accidents by freedom from the extension of coal dust explosions ?—Yes, that is my opinion. You see the number at present of falls of roof and sides of roads averages for the last 10 years, according to the tables, 157·7 fatalities ; in the accidents from dust explosions, or explosions the results of shot-firing, the average is only 22·8 per year. In one case you have over seven times the number of accidents, and if you put a percentage upon that seven times, you very soon get your 22·8 per year extra. I am quite certain that you might easily put 12 per cent. or 15 per cent. extra accidents if you had all your roads wet, because a great many of the accidents are in wet roads.

11359. Accidents from falls of roof and sides ?— Accidents from falls of roof and sides.

11360. Can you give us any evidence upon that point, as to how often the falls of roof and sides happen in wet roads and how often they happen in fairly dry places ? Can you answer that question ?—No, I cannot give you any statistics. It is only the general result of my experience owing to what I stated before—the slippery nature of the strata, and so on. For instance, if you get a wet road and you get your timber pushing out, a journey or tubs may come along and knock out the timber and perhaps break down three or four of your girders, and the horse driver, or the gang rider, or anybody who is there, may be under the fall, possibly. If you have the whole length of your roads subject to those conditions there will be a very much increased number of those cases, and the result will be increased accidents and increased fatalities. Then, of course, with regard to the gradients, instead of the roads being level and nicely graded, the lifting of the floor is disturbing them constantly, and you get humps coming up and down, and the speed of the journeys varies, and you have further accidents from that cause.

11361. Do you say that in nearly all the mines of which you have any knowledge the lifting of the floor is so serious that it would cause this sort of switchback system ?—In wet mines they are practically never still.

11362. You have noticed that in wet mines the roadways are always very much up and down—unlevel ?—Yes ; I have a case now where we started to make a tunnel a little over 12 months ago. The tunnel is something like 250 yards long, and about three or four months ago we started to work a seam out of this tunnel. That seam brought a little water, and the road, which was made 6 ft. high, is now in many places only 4 ft. in height ; and that is after repairs.

11363. Then do I understand you to say that in that road the floor is lifted in different places so much that the haulage road has become, if I may say so, a sort of switchback railway ?—Yes.

11364. It is not that the floor is lifted evenly along its whole course or anything like evenly, but that there are steep ups and downs ?—Yes ; this particular case, of course, is a tunnel, and the nature of the strata varies in different places. In a place where there is rock, of course, we should not get that lift, but anywhere where the strata are shales and metals we do.

11365. I understand you have not made any systematic inquiries as to the number of accidents from falls of roof and sides that occur in wet mines compared with the number in mines which are fairly dry ?—No ; there are no statistics available that I know of.

11366. At the same time, it is your opinion, based upon your long experience, that there are many more accidents from falls of roofs and sides in mines that are wet than in mines that are dry ?—Proportionately, yes.

11367. You also suggest that the number of sufferers from rheumatism, chest affections and colds would be increased if the roads were saturated ?—Yes.

11368. By "saturated" I suppose you mean that the roads must be very wet to occasion affections of that kind ?—Well, it practically means constant wet feet—putting it in that way.

11369. Then you say that you look more to the removal of dust where it accumulates than to watering ?—Yes.

11370. You say in your statement that you have always got the natural mine water to flow in a defined channel as soon as possible : so that so far from suggesting that the natural mine water should be used to water the mines all over—the floor, roof, sides and so on—you suggest that it should be collected together and should be made to run down some channel, so that the men can always walk dry about the mines ?—Yes, that is my practice. It is to avoid this constant movement of the ground.

11371. In the mines which you know about, how do the accidents from explosions total up ?—I have had very little experience of explosions myself. Of course, I can only take the statistics.

11372. That is to say, in your district ?—Yes.

11373. But as regards the particular 50 or 100 mines which you are well acquainted with, do you know whether the explosions in those are above or less than the average ?—I think they are less than the average in our district altogether.

11374. (*Mr. F. L. Davis.*) Do you consider the mines in your district are dry and dusty ?—Some of them are dusty ; many of them are dusty. Of course, that leads up to the question of the quality of the dust.

11375. (*Chairman.*) You will have something to say later about the quality of the dust. You suggest, in the first place, that it is better to remove the dust than to water the mines ; and in the next place you suggest that there should be increased precautions taken with regard to shot-firing in dusty haulage roads ?—Yes ; I should put it in this way—that you should first take every precaution to avoid the making of this dust, and then you should remove what is made ; and then in specially dangerous mines special regulations should be made for the shot-firing to be done under the most safe conditions.

11376. Then I suppose you would remove this dust by watering it in the first place ?—No, by simply sweeping it up and filling it out.

11377. But unless you damped it to some extent would not the dust fall out again ?—What dust you made in the sweeping would be carried along by the air current, but it would settle again further on.

11378. It would get somewhere ?—Yes.

11379-80. So that do you suggest you should sweep up what dust you could and put it in tubs ?—Yes.

11381. It has been suggested to us by another witness who tried this system of collecting the dust that it is better to wet the dust in order to prevent the dust escaping after you have collected it altogether ?—I have not usually done that.

11382. You have collected it quite dry ?—Yes.

11383. And sent it out in tubs ?—Yes, put it in tubs. You see, the man takes the tub along with him and fills the dust into the tub as he sweeps.

11384. But a good deal must escape, as you say, and go somewhere else and again have to be carted away ?—Yes ; as he goes forward along the road he starts and cleans forward and he catches the dust up eventually.

11385. Then you say that there must be increased precautions with regard to shot-firing, particularly, as I understand, where the quality of the dust is explosive ?—Yes.

11386. How would you test the quality of the dust being explosive ?—I presume that is capable of being tested, but I really do not know how you can make an effective test. I do not know that there have been tests which give us the proper amount of information. I notice that in the account of the Courrières explosion, dust containing up to 64 per cent. of combustible matter did not explode, but dust containing 71 per cent. of combustible matter did explode.

11387. That is to say, carbonaceous matter ?—Yes, carbonaceous and gassy matter—putting the carbon together with the hydrogens.

Digitized by Google

Mr. G. H. Hollingworth.

6 Feb. 1907.

11388. So that you think it has been pretty well established by the Courrières accident that if you were to mix coal dust—carbonaceous dust or inflammable dust—with 30 per cent. of some other kind of dust which was not explosive, that would make the whole mixture unexplosive?—That seems to be the result of the chemical observations there.

11389. Do you suggest it would be practicable to prevent dust explosions in that way, not only by carting away the dust, but if that was a difficulty, that you might prevent the dust from becoming explosive by adding to it about 30 per cent. of harmless dust?—No; what I suggest is that you need not wet a mine if the dust is not of an explosive nature.

11390. But you say that where it is of an explosive nature you would render it non-explosive by adding about 30 per cent. of harmless dust?—That appears to be the result of the test.

11391. Would you say that that was one practicable method of dealing with coal dust—that where it would be impracticable altogether or impracticable for the time being to clean a roadway and to make it free from dust, you might render the dust innocuous by mixing it with something else?—Well, I should rather put it the other way. I would rather move the dust than add to it.

11392. You would move the inflammable dust?—Yes. I do not see any use in bringing more dust to it. I would rather take the dust away.

11393. It has been suggested to us that instead of taking away the dust we might at all events, for the moment, render it innocuous by adding some other dust to it. However, you do not think that would be a practicable method of dealing with it?—No.

11394. But then I suppose you must assume that all the coal dust which you find in a mine, at all events if it is small coal dust—very dusty dust, as it were—is explosive?—I should assume that pure coal dust certainly is explosive, although I believe there are cases of coal dust which have not been exploded where they do not lend themselves to explosion—some qualities.

11395. But still, you are not aware of what the test is?—No, I do not know what the test is.

11396. Therefore it is only prudent to assume that wherever you get coal dust in a mine, or, at all events, small coal dust, that coal dust is explosive, and should be dealt with as such?—Yes.

11397. You say that the regulations that haulage roads should be completely watered in the vicinity of shot-firing should be cautiously applied. What do you mean by "cautiously"? Do you mean carefully applied?—I mean to say that any regulations for the watering of seams should be very carefully considered before they are made obligatory.

11398. But do you think that it should not be necessary to water 20 yards around a shot? That is the Rule as it exists now?—Yes.

11399. Do you think that is right or not?—I think there should be certainly precautions taken when you are firing amongst dust.

11400. You must have complete watering, I suppose?—Yes. What I mean is that you should not expect to drown that place for every shot, or you would be getting a great length of your road where you would be ripping in this wet condition, and you would have the difficulties which I suggest with regard to your repairs, and with regard to the movement of the road and the sides and the floor.

11401. Then you mean that not more watering should be applied for 20 yards round a shot than is absolutely necessary for the purpose of stopping a possible explosion?—That is so.

11402. Have you any suggestion to make with regard to that question, as to what sort of watering is necessary, and how much watering?—It seems to me that if a place is thoroughly damp that should be sufficient to stop an explosion.

11403. Then would you damp it by a spray rather than by a hose?—Yes, by sprays.

11404. You think that damping with a spray would be the proper method?—Yes; the usual custom would be to take a wagon of water in and to use that water just before the shot was fired.

11405. Drench the place 20 yards around?—Yes.

11406. Do you disapprove of that system?—No, I do not disapprove of that; I say you should do that, but if you go in for more than that then you begin to get to the point where you get your strata moving.

11407. You mean if you go more than 20 yards?—No; I do not refer to going a few yards further, but I mean that if you put more water on so as to thoroughly drench the place, then you do permanent harm in that way to your road.

11408. Then do you think that people are in the habit of applying too much water to the 20 yards around a shot?—No; but I think that if this watering is made compulsory in that way—thorough drenching, such as is suggested by some—that would do harm.

11409. But do you not disapprove of the ordinary practice which now goes on, of thoroughly wetting the mine for 20 yards round a shot?—I do not disapprove of that.

11410. You think it is done in the best way that it can be done; you think it is quite right that they should have a tub of water, or something of that sort, and should drench the place from that tub?—Yes; and, of course, only put sufficient on to lay the dust.

11411. That might be done either by a spray or by a hose?—Yes, or by an ordinary watering can.

11412. (*Mr. F. L. Davis.*) I think you draw a distinction between damping and drenching?—That is so.

11413. (*Chairman.*) So that you think that if the place is damp for 20 yards, that is enough without its being drenched?—Well, of course, sufficient to kill the dust.

11414. Then you would suggest that a spray would be quite sufficient for watering, with regard to shot-firing?—Yes, as much watering really as the dust would lick up.

11415. And you think it would be undesirable that any further watering should take place, and that it would be a distinct disadvantage by reason of making the chances of the roofs and sides falling in greater?—Yes.

11416. You think that during shot-firing the number of men in the mine should be limited, and that they should fire either between shifts or when there are very few men about, I suppose?—In specially dangerous places.

11417. But would you not say that anywhere near a haulage road was a specially dangerous place?—That entirely depends upon its condition as regards dust, of course.

11418. But is it not almost inevitable that you should have a certain amount of explosive dust in a haulage road?—A certain amount of dust. I do not know about explosive dust; it is not always explosive. It is a matter upon which the question of the mixture with other substances comes in; you see, you have to have nearly pure coal dust before it becomes explosive, according to the results at Courrières. With 36 per cent. of other matter mixed with the coal dust there was no explosion at Courrières, and up to 64 per cent. of combustible matter in the dust there was no explosion. At 71 per cent. there was xplosion, and at 72 per cent. there was explosion.

11419. Then you think that some distinction should be made between haulage roads where there is explosive dust which would be specially dangerous places, and haulage roads where the dust is so much mixed that you think there would not be any danger of an explosion?—Yes.

11420. And that in such haulage roads, and in haulage roads where the dust is mixed, you would allow shot-firing during shifts and while the men were at their work?—I do not know that one need be very particular about that, because you do not fire shots in your haulage roads when you are working the road.

11421. But I suppose an explosion might reach places where people were working?—Yes, but it would not be necessary to limit your men, say, to ten in that pit, if there were no explosive dust within reach of that shot.

11422. But then the difficulty is to find out what dust is explosive and what is not; it is very difficult, I suppose, to find out whether 30 per cent. of the dust is harmless, or whether it is not?—I should say there should be some inquiry as to what dust is harmless and what is not, and then there should be some precaution taken in the working of the mine to know that the dust was harmless. I do not mean that you would go into fine distinctions. If there is any doubt about it, the precaution should be taken.

11423. With regard to the amount of watering required to prevent the extension of an explosion, what is your opinion as to the length of wet zone that would be necessary to stop an explosion?—I really could not say. I should like to ask for some information upon that point myself; a certain length would do it, of course, because you would

Digitized by Google

get the heat from the results of the explosion reduced—you would get that heat below the ignition point on a certain length of wet cool road.

11424. Then I suppose you could express no opinion from your personal experience as to the stopping qualities of a dustless and dry zone?—No, it would be in the same way; but, of course, not so powerful.

11425. Exactly; you think you would require a much longer dustless and dry zone than wet zone?—Yes, I think so.

11426. Then you say that regard should be had to the effect of the temperature of the explosion of a shot and the temperature and moisture of the atmosphere. Have you made any experiments with regard to that?—I have not made any experiments on the subject, but I understand that certain explosives explode at a much less temperature than others, and of course the less the temperature the less likelihood there is of firing the dust.

11427. You think that ought to be taken into consideration, and I suppose is taken into consideration, in making up the list of permitted explosives?—Yes, it ought to be.

11428. Then it has been suggested to us that possibly every now and then, perhaps once in a million times, explosion occurs owing to a vortex ring being formed. Have you any knowledge whatever of that?—No.

11429. You say that the velocity of the air current must also be considered?—I think all those things may have some bearing upon the actual cause of an explosion.

11430. Then you would say that although you consider a dry dustless zone would probably stop an explosion just as a watered zone does, still you must have a very much longer dry zone than watered zone; and I suppose you think that experiments ought to be conducted with a view of finding out how far a dry and dustless zone would stop an explosion?—That is so.

11431. You have no information on that yourself?—No.

11432. You also say that we ought to consider the effects of mixture of mine gases, dust, and so on, and that all those matters should be subject to experiment. Then you refer to the standard of dryness. What do you mean by "a standard of dryness"?—The standard of dryness or wetness of the mine wants fixing.

11433. But I thought your idea was that it did not matter about a mine being dry, and that so long as the dust was collected and sent away it might be as dry as possible?—That is so, but still, if you are going to say that a mine is to be fairly watered if it is not naturally damp, you want to fix a standard beyond which you cannot go without putting in an apparatus or watering the roads.

11434. I suppose you would try and find out in any mine the standard of wetness which must not be exceeded?—The standard of dryness which must not be exceeded without wetting.

11435. Then there is a standard of dryness in a mine, in your opinion?—I want that fixed—to say how far you are safe when it is dry to a certain extent and when it really becomes necessary to begin to water it.

11436. I do not understand you; I thought from your statement you held that a mine might be absolutely and completely dry, as dry as a mine could possibly be, and yet it was not necessary to water it at all if only you took out the dust?—That is so—if you remove the dust you remove the whole mischief.

11437. You mean that if a mine is very dry and you cannot remove the dust, then the question of watering comes in?—Yes.

11438. Is that a second alternative?—What I really mean is that it ought not to be compulsory to water any mine in a drastic fashion unless certain conditions appertain to it, and that a standard of the safety of the mine is required; that is to say, that you need not do anything if you are below a certain standard, whether the mine is dry or not, if your conditions are such—that is to say if it is damp.

11439. If it is damp up to a certain point you need do nothing, I understand?—Yes, you need do nothing.

11440. But supposing it is dry and dusty?—Of course you have to deal with that dust in some way if you are going to fire shots.

11441. And you say you cannot always deal with it effectively by removing the dust. You say that is the best way of dealing with it, but you cannot always deal with it effectively in that way?—That is the way in which I should propose to deal with it myself, rather than water.

11442. But I understand you to say there are mines which are very dusty, which apparently you cannot make safe simply by removing the dust?—No, I do not say that; I think you can.

11443. You say that however dusty a mine is, if proper means are taken to remove the dust there is no danger from explosion?—That is so: if you remove the dust there is no danger from explosion, and I do not know of any case in which I would not sooner remove the dust than water.

11444. You know of no case?—No case.

11445. But you would make it imperative upon a mine-owner either to remove the dust or to water—of course there must be something done?—Yes, up to a point, and then you want to know the line at which the mine-owner must commence to water.

11446. Then in shot-firing in dry mines, if you completely denude or as completely denude a mine of dust as it is capable of being denuded, do you say you would allow shot-firing without watering?—Well, you could do it then; and of course the amount of watering required would be proportionately less to the small amount of dust that was possibly remaining.

11447. But still you would not say that you could ever reduce a dry and dusty mine to such a condition of safety as that it would require no watering at all in the case of shot-firing: you would not go as far as that?—I think you would get very near to that, and that the watering would be simply an extra precaution.

11448. But it is an extra precaution which ought to be taken?—Yes, and of course the amount of watering required would be very small in that case, and would not do the harm that I apprehend.

11449. Therefore, you say that it is perfectly possible in a mine, however dry and dusty it may be, to have a system of collecting the dust that will make it perfectly free from the danger of explosion except in the case of shot-firing?—Yes.

11450. And that in the case of shot-firing it might not be necessary to water, but at the same time it might be desirable as a precaution?—Yes.

11451. With regard to the standard of sufficiency of watering, you suggest that a very slight watering would be sufficient, for instance, watering with a spray for shot-firing, supposing you have dealt with the dust in the best way you can?—Yes, if you have dealt with the dust.

11452. And dealt with it sufficiently, as you consider, by removing it altogether from the mine: then you say that with regard to the shot-firing it would be quite sufficient to simply damp for 20 yards around the shot?—Yes, to a very small extent.

11453. And not to have a regular drenching?—Yes.

11454. Then you say that if watering is essential the zone system is preferable to general watering. Supposing there were great difficulties in removing dust from a mine, and a mine-owner were to consider that the zone system of watering would suit him better and would be less expensive, you would agree, I suppose, that that might be so?—Yes.

11455. And then you might, I suppose, even in mines where there were great difficulties in the way of falls of sides and roof, have a wet zone bricked?—Yes, you could have that. If you had to have a wet zone, it would be simply a question of what is the best method of having that wet zone: what would suit you best in the end and be less trouble and less expense, and in that case a permanent lining would be the best thing to have.

11456. Because, in your opinion, even if you had a wet zone, that zone would be a dangerous zone from falls of roof and sides?—Yes.

11457. I do not understand you to say that you have come to any definite conclusion as to whether a dustless zone would stop an explosion or not. You think that question ought to be experimented upon?—Yes, I think it would, but I have no experimental knowledge on the question, and it is a question of what length of dustless zone would stop it—how far an explosion would leap. That is a thing which requires ascertaining, and it is a matter which would vary with a lot of circumstances, I presume: the size of the road would have something to do with it

Digitized by Google

Mr. G. H. Hollingworth

6 Feb. 1907.

11458. With regard to preventing dust accumulating in a haulage road, you would naturally say that it is extremely desirable that there should be tubs in use which held coal tight and did not allow dust to get out?—That is so.

11459. With regard to spraying the journeys, some people object to spraying the coal on the journeys; they say it injures the coal, and they suggest that the coal should not be sprayed?—It does not improve it; that is very certain.

11460. But still, on the whole, you are of opinion that it would be desirable, as a means of preventing the dust from accumulating, that coal wagons should be sprayed?—Yes, where the circumstances are such that there is, for instance, a high velocity of air current sweeping the fine dust off the tops of the tubs, spraying would stop that if it was done efficiently.

11461. Do you think there ought to be any regulation prohibiting tubs being filled up above the sides?—I do not think that is necessary. Of course in the case of tubs being filled up above the sides, it is nearly always with large coal; the small coal is very seldom filled up above the top.

11462. But still, where small coal is filled up above the top, that, no doubt, makes accumulations of dust in the haulage roads?—Yes, it is more liable to be blown off and shaken off in that case; but, as a rule, the coal finds its level before it has got very far from the face.

11463. If an owner were to decide to proceed in that way by collecting the dust rather than by watering, then it would be to his interest to see that as little dust as possible should fall, because he would have to collect all the dust that fell?—Just so.

11464. So that in that way it would be more to his interest, under a system of removing the dust, to see that proper tubs were constructed than it would be if he was to trust to watering?—Yes.

11465. (*Mr. Cunynghame.*) I notice from the returns that there are a great many more explosions in some districts than others?—Yes.

11466. Your experience has been chiefly in the North Lancashire district?—Yes.

11467. I notice that that is very remarkably free from explosions?—That is so.

11468. To what do you attribute that, or have you any explanation to give me; for instance, to put it more pointedly, why are there so many fewer in Lancashire than there are in South Wales?—There are two or three reasons which might be given: one is, of course, the general precautions taken with regard to shot-firing and the general discipline of the mines.

11469. We will pause there for a moment: I will take all your reasons in detail presently, but that one which you have given is important. Now what are the precautions that are present to your mind which are taken in Lancashire more than in other places?—As far as regards other places, for instance South Wales, I do not know very much about it.

11470. Will you tell me what was in your mind when you gave that answer?—That the Regulations of the Coal Mines Regulation Act and of the Explosives Order are very carefully carried out, and there is a general knowledge amongst the officials that coal dust is dangerous.

11471. What precaution is it that is particularly present to your mind when you say that the rules are being carried out? What precaution is taken in Lancashire, for instance, that is not taken so much elsewhere?—Well, I do not know. Of course we are all subject to the rules, and it is to some extent in the carrying out. I think they are better carried out generally in Lancashire than they are, say, in South Wales.

11472. (*Mr. F. L. Davis.*) But I thought you did not know as to South Wales?—No, but I am speaking now of the reputation more than anything else.

11473. (*Mr. Cunynghame.*) That seems to be rather more an impression than anything else?—That is so.

11474. I am asking you to prove it; but it is more an impression than a statement of fact?—That is one of the things I cannot prove; it is one of the things which I say may lead to it.

11475. I will not pursue it further; that there must be a cause seems pretty obvious, because it goes on year after year, whatever the cause is?—Yes.

(*Mr. Ratcliffe Ellis.*) You might give us the practice in Lancashire, and then we might deduce from that.

(*Mr. Cunynghame.*) I did not wish to go through the whole practice. Can you mention any particular thing with regard to which care is taken in Lancashire which is not very much attended to elsewhere. You have told us that you think they are generally more careful. Is there any particular point upon which you think they are more careful?

(*Mr. Ratcliffe Ellis.*) For instance, shot-firing.

(*Witness.*) No; I think the regulations are very carefully kept, and that the discipline with regard to shot-firing is very good.

11476. (*Mr. Cunynghame.*) Is there anything done in Lancashire in regard to shot-firing that is not done elsewhere?—There is nothing done in shot-firing more than is done elsewhere.

11477. Your impression is that the Rules are better obeyed?—Yes.

11478. But that does not come to more than an impression?—No; that is one of the things that may lead to this result.

11479. Do you know anything with regard to safety-lamps?—Safety lamps are very generally used in Lancashire.

11480. Are they more used there than in other districts?—More than in some districts, yes.

11481. Which district, for instance?—I am speaking now from memory of the statistics; but there are a great many places in Scotland where safety lamps are not used. I understand from the evidence that there are a great many places in South Wales where safety lamps are not used.

11482. And where possibly they ought to be used?—Where they ought to be used—where I would use them.

11483. But the truth is that it does not come to more than an impression after all, does it? You see, we want what information you have that is positive.—Yes, I understand.

(*Mr. F. L. Davis.*) It is very difficult, as you do not know the other district.

(*Mr. Cunynghame.*) I am telling you frankly that it does not impress my mind as more than an impression.

(*Witness.*) Yes.

11484. The undoubted fact is that there are fewer explosions in Lancashire, which you have a general impression is due to greater observance of the Rules. Beyond that I do not think we can take it.—That is one point, of course.

11485. I gather that your objections to watering are placed on four grounds:—expense, liability to breakdown of roofs, the difficulties of handling wet coal and props, and health. Those sum up the four objections?—Yes.

11486. I will take those in order: First of all, expense. Now, how much per ton do you estimate that watering would add to the expense of getting coal?—I have not been able to go into that in detail; but you see, according to the German Report, you get about 1½d. per ton for the absolute watering. I am quite sure that the other expenses in the roadways would be fully as much as that—that is to say, the extra expense and repairs.

11487. (*Mr. F. L. Davis.*) Is that 1½d. per ton maintenance?—Yes, maintenance.

11488. (*Mr. Cunynghame.*) There would be 1½d. per ton: you would take that from the German figures. Now, do you complain of those figures, or do you agree with them.

(*Chairman.*) I understood him to say there would be one 1½d. and another 1½d.

11489. (*Mr. Cunynghame.*) Then there would be 3d. per ton in your opinion. You tell us it is more expensive, and naturally I answer that is a general impression. Now I want to know upon what basis you put that; is that mere impression and does it end there, or have you figures and facts which you can bring before us to prove your impression?—I have no figures and facts, because it is impossible to have such figures unless you first have a dry mine and get your figures from that, and then commence to water it and get your figures afterwards as to that.

11490. Then it comes to this, that your evidence as to the expense of it is an impression, but it does not go further than an impression?—It is the result of experience.

11491. Now let us have that experience; what experience is it based upon?—Comparing the working of a dry mine with the working of a wet mine.

Digitized by Google

11492. Will you give us the facts? Where was the wet mine that you are thinking of?—I have a particular mine now where there is constant trouble in the roads because they are more or less wet.

11493. Naturally wet?—Yes. I have another mine where the conditions are that it is dry and where you have no trouble in the roads except in a very ordinary way. When you have once set your timber in the dry mine you know it is there for a length of time; when you have set it in the wet mine you do not know that in a few days or a month you will not have it to do again.

11494. I will take the case of that wet mine. How much do you estimate, or can you give any estimate of the extra cost of getting the coal to the surface in a wet mine?—I cannot exactly.

11495. Can you give us any idea at all?—No. I should say that it would be considerably more than the 1½d. per ton that I mentioned in this particular instance: that is my impression.

11496. How much water flows out of that mine, say, taking 100 yards of roadway—or put it in any way you like?—It does not come in that way—the absolute wetness of the mine. Of course it comes at intervals, but of course the water flows along the roadway.

11497. Is there not far more water in that wet mine which you are thinking of than would be produced by any amount of artificial watering?—I do not know, because there is not much altogether.

11498. But how much is there?—20,000 odd gallons of water for 24 hours—call it 1,000 gallons an hour.

11499. What is the total length of the roadways of that wet mine which you are thinking of?—I should think there are 6,000 or 7,000 yards altogether. The main haulage road is about a mile long—about 1,800 yards.

11500. That comes to 20 gallons every seven yards, and that amount comes out in the 24 hours?—Yes.

11501. How would that compare if you were artificially watering; supposing you wetted all those roadways, how many gallons of water would you put in the 7,000 yards of length?—I cannot say, but I can say this, that that 20,000 gallons of water is collected as soon as we can get it into a channel on the deep side of the road.

11502. But I want to come to this question: is this mine that you are thinking of much more wet, or only as wet as would be produced by artificial watering. Will you answer carefully?—It is not as wet as would be produced by artificial watering.

11503. Do you mean that with artificial watering you would put much more than 20,000 gallons in that mine?—No, I do not mean that. You see that 20,000 gallons is collected as soon as we can collect it and it is run into a channel. There are places in that mine which are dry. There are places which are only damp, and there are places where you can hardly find any water.

11504. (*Mr. F. L. Davis.*) There may be water coming from a spring. You do not mean that the whole mine is wet because you have that quantity coming from one portion of it?—No.

11505. (*Mr. Cunynghame.*) But I want a comparison if I can get it; if you are not able to give it, I cannot get it of course. With regard to handling wet coal and timber, at what would you put the extra expense?—It is impossible to say. I should put that more upon the matter of danger—in the repairing. It is not wet coal I am speaking of, but wet stone.

11506. As a fact, are there more accidents in wet mines, on the percentage of men employed, due to falls of roof and handling timber than there are in others?—That is my experience.

11507. We can hardly test that. You have not any particular mine in your mind when you answer that, have you?—No.

11508. Now with regard to health, have you any actual facts which you can give us as to the health of men in wet mines as compared with the health of men in dry mines?—Yes.

11509. Not impressions I mean, but things we can rely upon?—This is simply the result of experience. I cannot say that in a wet mine I have 5 per cent. or 10 per cent. more people off from sickness or anything of that kind: all I can say is that cases of rheumatism and that kind of thing are continually cropping up in a mine which is wet in a way in which they do not crop up in dry mines.

11510. Your remedies, I understand, are as follows: removal of dust, blasting between shifts, restriction of shot-firing in dusty haulage roads, and greater care in the use of explosives?—Yes.

11511. We will take the question of the removal of dust; how much dust per yard in an ordinary roadway would be sufficient to render it likely that an explosion would spread there; what is the dangerous quantity to leave, in fact?—I should say it would not take very much, but that is one of the points I should like some information upon; I could not say what quantity of dust distributed in a certain cubical capacity will explode.

11512. But is it essential that one should know how much that is left is dangerous before one can say that sweeping or removing it will deal with that?—Yes, that is exactly what I should like to know: if you would tell me what quantity, then I should know how to deal with it.

11513. But I confess I should have thought more of the proposal to remove dust by sweeping if it had been put forward by someone who could say how much dust left was dangerous. If you have not considered the one, how can you possibly form an opinion upon the other?—The removal of that dust may have prevented my having a practical experiment.

11514. Yes, but what I mean is this: you propose brushing the dust down, but unless you know how much dust left would be dangerous, or unless you are prepared to say that a person should remove every atom, then it seems to be an impression only?—My common sense tells me that you must have a fair amount of dust before you can get an explosion.

11515. I ask you how much?—I cannot tell you the amount. I know you put a certain number of pounds and blow it up with a fan and explode it in a chamber.

11516. Would 1 lb. in 10 yards of a roadway be sufficient to cause an explosion?—I suppose that would depend upon the size of the roadway.

11517. Would it be possible by any amount of brushing to undertake that there should not be 10 lbs. of dust left in four yards of roadway?—I should think it is quite possible to do that.

11518. On the top of the timbers that are under the roof?—Anywhere accessible from the roadway.

11519. You think you could guarantee to sweep to that amount and to keep it swept?—Yes.

11520. Now as to blasting between shifts, could that be done to a much larger extent than it is done at the present in your district?—It could be, but it entirely depends upon the working conditions of course.

11521. But I am asking you the question taking the working conditions. I will divide the question into two—both at the face, and on the roadways?—At the face it would be difficult in mines where coal is usually got by hand—you could not very well do it.

11522. You could in some mines, I suppose?—You could in some.

11523. It could be done more than is done at present?—Yes.

11524. And in roadways it could be done much more than it is done at present?—Well, that depends upon how you put it; you could have it carried out in roadways, leaving a certain number of men, much more than it is done at present.

11525. That is what I mean—leaving only a certain number?—But that introduces practical difficulties in the working.

11526. What are the difficulties that it introduces?—Well, you have to set aside a period during which this shot-firing must take place in your roads, and you have to clear your pit of all men, no matter what operations you have going on at that particular time.

11527. But can you not do that during the time when the men are naturally away from the mine altogether?—I have a mine working where men are never naturally away.

11528. You mean with three shifts going?—Two shifts of coal-getting and one for repairs.

11529. What proportion of men would be down the pit during the repairing shift; out of 1,000 men how many would be down during the repairing shift?—It would be perhaps 100 in that case.

11530. It would be much safer to do the blasting during the repairing shift, would it not?—Yes.

11531. Of course I refer to blasting in roadways?—Yes.

Digitized by Google

Mr. G. H. Hollingworth.

6 Feb. 1907.

11532. (*Mr. Ratcliffe Ellis.*) In Lancashire the permitted high explosives are usually used?—Yes.

11533. One of the provisions of the Explosives Order is that shots must not be fired in the main haulage roads and intakes, except between shifts, unless a permitted explosive is used and the place is watered; that is obligatory?—Yes.

11534. But in the face you do not think much more could be done?—No; your conditions of working would mean that you must have your shots going as the work is done.

11535. But, you know that there are cases in Lancashire where shots are fired in the face between shifts?—Yes.

11536. (*Mr. Cunynghame.*) I am asking whether shot-firing could not be carried on with much more safety?—I think it could.

11537. You mention that as one of your remedies?—Yes; that is more particularly as regards the haulage road. It is not so much as to the face.

11538. As Mr. Ratcliffe Ellis points out, you have Section 3 of the Order with regard to that?—Yes.

11539. I suppose that the effect of blasting between shifts is really two-fold in diminishing danger. First you have less men in the mine to be affected; and, secondly, if you have blasting between shifts it will be done by more experienced men, and done with greater care?—I should not like to say that, because the men who do the blasting are all selected men.

11540. But in many places in England the coal-hewers do their own blasting, do they not? I am dealing with in the face now?—Yes.

(*Mr. Ratcliffe Ellis.*) In Lancashire in certain places the men fire their own shots; in other places the shots are fired by a shot-firer during the working hours; and in other places they are fired between shifts, not in working hours at all.

(*Mr. Cunynghame.*) But will not the firing between shifts which is done by selected men be an element of safety as compared with the firing done by the hewers which is not done between shifts?

(*Witness.*) Oh, yes; there is no question of the difference between the firing between recognised shot-lighters and the firing done by hewers.

11541. Then firing between shifts produces two advantages—not only that there are a less number of men in the mine, but that probably greater care is exercised in the conduct of the operation?—Yes.

11542. You agree with that?—Yes.

11543. But when you are firing between shifts, would all the shots be fired in every case—face and roadways—by specially experienced men?—In certain collieries.

11544. And in certain other collieries it would be done simply by anybody?—In certain collieries there are always shot-lighters.

11545. But in certain others you imply that there are not—is that so?—That is so. There are collieries where the hewer fires his own shot.

11546. Between shifts?—No, not between shifts.

11547. But the question, as Sir Lindsay Wood reminds me, is this: is it the fact that, in some places where there is blasting between shifts, that blasting between shifts is done by the ordinary workmen and stone-men?—No, I do not know of any such place.

11548. I only want to know whether there is anything in the point that in blasting between shifts you get rather more care exercised. You agree with that apparently, or if you do not, will you say so?—You do in some cases.

(*Mr. Ratcliffe Ellis.*) It must be so, because when it is done between shifts the hewer is not there at all, and the person who is appointed to fire the shot is the person to do the work.

(*Mr. Cunynghame.*) That is exactly what struck me. I want to know, as you come here as an expert, whether you agree with that theory?

(*Witness.*) Yes, except in the case where all the shots are fired by experienced men appointed for the purpose.

11549. I am speaking only of shots between shifts?—Those are equal to the shots fired at any other time where the properly appointed shot-lighter fires all shots.

11550. The risk is not greater in that case?—No.

11551. But in cases where the men fire their own shots there would be a greater element of danger?—Yes.

(*Mr. Enoch Edwards.*) Those would be very few cases, I think, in these days.

11552. (*Mr. Cunynghame.*) They are very few, I understand, from what I have heard, but at all events the point is a good one for what it is worth. Now as regards the testing of dust, I think you told us something about the quality of dust at Courrières. The dust at Courrières contains, does it not, 30 per cent. of volatile matter; it is the volatile matter we are dealing with—not foreign substances?—I took the proportion of combustible matter roughly—that is, the carbon and the volatile matter together.

11553. But where did you get that figure from?—From a paper by Mr. Atkinson and Mr. Henshaw on the explosion.

11554. Will you take these figures from me; is it not a fact that the dust at Courrières contains 30 per cent. of volatile matter, the remainder being made up of carbon?—I only see two instances in the list where there is 30 per cent.

11555. Coal does not contain 70 per cent. of non-carbonaceous matter; the dust contains 30 per cent. of volatile matter. Are you aware that some coal contains as much as 45 per cent. of volatile matter, which is about the greatest quantity that has been found?—This dust at Courrières contains quantities varying from 15 per cent. to 30 per cent. of volatile matter.

11556. And the rest is made up of carbon?—Carbon and ash, this particular dust.

11557. Well, carbon and ash after it is burnt?—No, it is before it is burnt, because it is the dust which did not explode.

11558. What is the average proportion of the ash? I want to get at what you meant by your argument just now, that is all?—What I mean is this: I have before me No. 8 experiment here: "No. 3 Pit, North Bowette 280, about 400 metres north of pit, no explosion; 38·45 per cent. carbon, 25·55 per cent. of volatile matter, 36 per cent. of ash."

11559. That is what I mean; it is the volatile matter. That is the important point in the explosion, is it not?—Well, you get there 25 per cent. of volatile matter.

11560. And sometimes you get 30 per cent., and, as you are aware, sometimes as much as 45 per cent. of volatile matter in coal?—Yes. Of course you get a good deal less in other coals also. That is one of the points that I say we want some information upon—as to how far it affects the explosive quality of the dust.

11561. But I suppose it is a very easy matter to test it chemically and not a very difficult matter to test it practically?—Yes, but when you have got your analysis what we want to know is what quantity of volatile matter and carbon you can go up to before it becomes explosive I say the carbon has something to do with it.

11562. You say that the carbon as well as the volatile matter has something to do with it?—Yes.

11563. And the ash?—Yes.

11564. That you have to consider the three?—Yes.

11565. I suppose the character of the explosive has to do with it also?—Yes, that is what I think.

11566. And the temperature of the explosion?—Yes.

11567. But gunpowder has a very low temperature, has it not, and that is the worst. Do you not think that what we call the slowness of the explosion has even more to do with it than the temperature?—Of course that is one of the points, there is no doubt at all.

11568. And the most important, I think?—Yes. Of course gunpowder in one sense is not an explosive, it is a combustible.

11569. Have you had any experience of firing Bobbinite, by any chance?—Yes, but not recently.

11570. What would you say of that as an explosion-producing explosive as compared with some others?—There has been an enquiry with regard to Bobbinite, and a large amount of information has been got upon it, but I am not sufficiently experienced to speak with regard to it.

11571. (*Chairman.*) There is one matter which has been brought to my notice with regard to shot-firing in Lancashire. Mr. Hall (the Inspector) said in answer to *Q.* 1393 that it would be quite impracticable that you should require every shot in coal to be watered, and quite impracticable to carry it out. He appeared to think that the provision in Rule 12 (*h*) was set aside by the Explosives Order, and that unless it was in a haulage road it would

Digitized by Google

not be necessary to water for 20 yards around. Do you know whether that is so?—I have not had any experience as regards watering in coal in that way; but, of course, you are only subject to certain restrictions when your pit is or has been in a certain condition. But certainly it would be quite impracticable in many mines to water at the face every shot in that way.

11572. In point of fact, then, it is not done—it is a dead letter?—It may not be necessary.

(*Mr. Ratcliffe Ellis.*) It may not be dry and dusty.

(*Chairman.*) No, but if it is dry and dusty it is necessary under Rule 12 (*h*). Would you say that the Rule is not carried out: that a mine may be dry and dusty and yet you do not water at the face? It is perfectly clear, apparently, that if Rule 12 (*h*) does mean that in every dry and dusty mine no shot shall be fired even at the face unless watering goes on, that Rule is not attended to. But Mr. Hall appeared to think that the reason why they were not obliged to attend to that Rule was owing to the Explosives Order.

(*Mr. F. L. Davis.*) But you would not consider those places to be dry and dusty at the face, I suppose?

(*Witness.*) That is one of the points, but I should take it generally that the impression is that permitted explosives can be used more freely than you can use gunpowder, for instance. The original Rules were drawn up for gunpowder.

11573. (*Sir Lindsay Wood.*) I should like to ask you if all the remarks you have made in your notes apply to shot-firing at the face as well as shot-firing in the haulage roads, or are they only confined to the haulage roads?—It is the haulage roads I am dealing with more particularly.

11574. In your opinion it would not be necessary to deal with all the dust in the working places?—No, that would be getting to the impossible.

11575. It is only as to the shots being fired in the main haulage ways?—Yes.

11576. I think you said you had not had any experience as to the quantity of dust in suspense in an airway which would cause an explosion, or rather, be the means of danger by spreading an explosion?—No, I have not had any experience. There are only the published accounts of the tests to guide us, but that is all I have seen upon that.

11577. Mr. Cunynghame asked you whether 10 lbs. every four yards would be sufficient?—Yes: I cannot say.

11578. That, of course, is a very small quantity, practically only ·0146 of a lb. per cubic foot?—Yes.

(*Mr. Cunynghame.*) It would be enough to produce or, at all events, to continue an explosion—enough to make an explosive mixture. An extremely small quantity is sufficient even to originate an explosive mixture, but it would very rarely originate it, no doubt. Very little dust would do it: perhaps Dr. Haldane would know the amount.

(*Dr. Haldane.*) You can calculate the amount of dust that corresponds to the amount of oxygen in the air, and can get some idea by that method.

(*Sir Lindsay Wood.*) I thought it was practically impossible to sweep a mine so as to leave only 10 lbs.

(*Mr. Cunynghame.*) I am afraid you would still leave dust enough, whatever sweeping you could do, to be a source of danger. That is what I should like to hear evidence upon.

11579. (*Sir Lindsay Wood.*) The next point is this; do you think in firing shots in the main haulage roads there is ever gas?—Very seldom. The main haulage roads are nearly always in the intake.

11580. Of course it would be a very serious breach of the Rule if gas was fired in the main ways?—Yes; the man would be prohibited from firing the shot, of course.

11581. But at present there are sufficient precautions taken to prevent gas being lodged in main roads?—Yes, I should think so. It would be a very abnormal state of things if there were gas in the main haulage roads, whether they are returns or intakes.

11582. And the source of the explosion is the firing of a shot in the main haulage roads. I am confining it to main haulage roads?—Yes.

11583. Then if shots were prohibited in the main haulage roads that would cure everything?—That is so.

11584. I only want to know whether that is your opinion?—Yes, that is so—it would remove that cause entirely.

11585. Then if you had a sufficiently wet ground for every shot that was fired in the main haulage road, would that be sufficient to stop it?—Yes.

11586. That is if it were wet for a sufficient distance, and if there was sufficient wetness?—Yes; that is quite common sense.

11587. Without watering all the remaining part of the mine?—Yes.

11588. You consider it would be dangerous to water many parts of many mines—in the main haulage roads?—Yes.

11589. Do you find that your floors heave, as I call it—that the bottom comes up and swells?—Yes, with water.

11590. With dampness?—With dampness, even.

11591. As well as with heavy watering?—Yes.

11592. That would be by reason purely of dampness without any additional watering at all?—That is so.

11593. Is that equally as bad as heavy watering?—I should not say it was equally as bad. It is not as quick for one thing, but still it is there. A dry mine will remain stationary and a damp one will heave, and when you get to an extreme quantity of water it begins to go quicker and the pushing of the sides and the undermining altogether takes place.

11594. But the dampness does cause the fireclay, or whatever it is at the bottom, to swell?—Yes.

11595. And that causes the damage?—That is so.

11596. I think you said you estimated the cost at about 1½d. per ton for the absolute watering, and at about 1½d. per ton for the up-keep?—Yes. I think 1½d. per ton for the after effects is quite a small estimate.

11597. Do you consider that that would be a large sum or a small sum, taking the quantity of output, say, at 1,000,000 tons per annum?—It is a very considerable item.

11598. Compared with the margin of profit, at any rate?—Yes.

11599. (*Mr. Enoch Edwards.*) I understood you to say that your experience has been mainly in and about Manchester?—That is so, principally. Of course I have had some experience of other districts.

11600. You have had no experience of explosions?—Very little, I am thankful to say.

11601. It is suggested that the number of explosions is very few in Lancashire?—Yes.

11602. That would apply particularly to the Manchester district?—Yes.

11603. Lancashire had its share of explosions 30 or 40 years ago?—I think about 30 years ago it had more than its share.

11604. I understand you to suggest that in your judgment this better condition of things, of there being fewer accidents, has been brought about by the management and by greater care on the part of the men?—Yes.

11605. Would you consider Hyde Colliery to be in the neighbourhood of Manchester?—Yes.

11606. That disaster was not so long ago, was it?—I think it occurred 20 years ago.

11607. Are the mines in and about Manchester mines which are regarded as dry and dusty mines? Some; there are both sorts.

11608. You have not seen the Welsh mines?—I have seen mines in North Wales.

11609. Have you any experience of mines in South Wales?—I have not seen the mines in South Wales.

11610. So that you are not prepared to give an opinion as to whether they are very much drier and dustier than the mines in your district?—No.

11611. You have referred to accidents from falls of roof and sides; will you explain to us how those accidents happen?—There is the ordinary accident where a lump of roof falls down and somebody happens to be underneath at the time.

11612. Are you referring to the roadways?—I am speaking of roadways more particularly. The figure which I gave was for the roadways entirely.

11613. Would not those accidents in the roadways happen rather to men during the repairs of the roadways?—A good many of them. The figures are given in the statistics; there were 918 in the 10 years ending 1905, during repairs, and 659 whilst otherwise working or passing.

Digitized by Google

Mr. G. H. Hollingworth.

6 Feb. 1907.

11614. So that the great bulk or the majority of those accidents happened to men who were engaged in taking out timber and putting other timber in—lining roads and repairing them?—That is so.

11615. You said in answer to the Chairman and to Mr. Cunynghame also, that in your experience these accidents are greater in wet seams?—Yes.

11616. When you refer to wet seams you mean shallow seams?—No, not necessarily, but seams in which there is a considerable amount of water.

11617. But you do not get water in the seam to any great depth, do you?—Yes.

11618. How deep?—Up to 400 yards, at any rate.

11619. But is that not water that comes from the upper seams?—No, it comes out of the roof—and some through the coal, of course, but not so very much.

11620. Those are very rare cases at 400 yards in depth are they not?—No, not particularly. It all depends upon the nature of your strata; if you get a thick rock immediately above your seam, that would charge itself with water, and you would have to deal with it.

11621. You would not have a dry and dusty mine in that case?—Well, it might be dry and dusty in every part but where the breakdown was.

11622. In your experience accidents have been more frequent in those mines yielding water—wet or damp mines—from falls of roof and sides than they have been in dry mines?—Yes.

11623. Have you had any experience at all of watering dry and dusty roads?—No, not artificial watering, but I have had experience of roads which were dry at one time, and which afterwards, through water being tapped, became wet.

11624. What is suggested now as regards watered zones in mines you have not had any experience of?—No, only just the ordinary watering for shot-firing.

11625. So that you base your opinion of what might happen upon what you have seen in those damp mines?—Yes.

11626. Is it possible in your judgment to so keep haulage roads that an explosion could not continue?—I should think it is possible.

11627. What is your opinion of dry zones of archways—brick or cement—with smooth sides for a distance?—I should say they would be effective.

11628. I understand your objection to watering is an objection largely to the cost of it?—Cost and accident.

11629. You say in your statement that in many dry and dusty mines compulsory watering would mean closing the mines?—Yes—unless of course, they could get a higher price for the produce.

11630. Of course this Commission has not been appointed to fix the price of coal?—No, but that is the governing question in coal mining.

11631. If, as suggested, you got a length of roadway arched, and if that was sufficient to prevent an explosion carrying—the term used is "stop an explosion," and what is rather meant I suppose is that there would be nothing to feed it upon, but you would take away the material which would feed it, and then it would stop itself—you think that could be done by these means?—Yes, I think so. It is only a question of the area of the archway and the length of it. Those are matters which we require information to fix.

11632. Of course you are not in a position to give this Commission more than—I think you used the term—your common-sense view?—Yes.

11633. Everybody has tried to look at these questions with regard to safety from a common-sense point of view; but you are not in a position to give this Commission any clear or definite evidence from your experience as to what the cost of watering roads would be?—No, because I have not tried it.

11634. I should like you to help us to clear up, if you can, a point which Mr. Cunynghame was putting to you with reference to firemen and firing shots between shifts. Are there any cases in Lancashire within your knowledge where in dry, dusty and gassy mines, a collier would be allowed to fire his own shots?—No.

11635. You do not know of any?—No.

11636. You do not know of any in any district where they are dry and dusty.—No.

11637. But it is the rule that a competent shot-firer, with knowledge of his duties, should be appointed?—It is a part of the Rule of the district.

11638. And it is carried out?—Yes. The only cases I can think of which are an exception are those of mines where candles are used, and of course in Lancashire there are very few of them; they are just a few small mines in the mountains; but those are nearly always wet.

11639. So that the suggestion that you should have men who would use greater care in firing shots in the main haulage roads when the pit is not working, and that those men would be more competent than the men you have in the daytime to do that work, is not justified in your experience in Lancashire?—No. The Explosives Order says in Rule 2 that every charge shall be fired by a competent person appointed in writing.

11640. And that is pretty generally carried out, is it not?—Yes, it is bound to be carried out.

11641. (*Mr. Ratcliffe Ellis.*) You agree that there is some dust in mines which is extremely dangerous?—Yes.

11642. Some you think is not dangerous at all?—That is so.

11643. Have you any information, or do you know whether there is information obtainable, as to whether the dangerous dust could be attributed to any particular seam?—No. I know that it varies, and that various qualities of dust are explosive in various degrees, and some not at all.

11644. Do you know whether any experiments have been made to ascertain that?—I think Mr. Hall made a number of experiments in which he tested various sorts of dust and found varying results.

11645. Dust from different seams of coal?—Yes.

11646. So that the dangerous character of the dust from one seam could be described, and the less dangerous or non-dangerous character of dust from another seam?—Yes.

11647. Do you think there are experiments made to find that out?—I think experiments have been made for various dusts, and it is of course quite competent to make them for any dust upon the same lines.

11648. Do you think it would be very useful to obtain information of that kind?—Yes. I think for instance that if a colliery was dusty that dust might be tested, and if that dust was found to be like some of this dust at Courrières—non-explosive—and dust that would not carry an explosion on, I think that might very well be treated in a different way to dust which was explosive.

11649. Whatever was done with regard to that, do you think that that information would be very useful if it could be obtained?—Yes.

11650. So far as you know, is that information obtainable from any source now, except from further experiments?—No.

11651. In cases in which the seam is dry and dusty where would you expect to find the dust—at the face, or elsewhere?—It depends upon what you call "dust." Fine dust you would not find so much at the face.

11652. The fine dust is the most explosive?—It is the most explosive—the finer it is the more explosive it is, I take it.

11653. Of course air is coming round the face in considerable quantities, and that would tend to carry the dust away from the face?—Yes, the very light dust, certainly.

11654. Is it within your experience that it has been shown that the further you get from the face along the roads, the larger the quantity of dust you find deposited?—That is in the direction of the winding shaft, I presume you mean.

11655. Yes, you would expect that to be the case?—Yes, unless the roads are clean. As regards the spilling of coal, it occurs pretty close to the face.

11656. I am talking about the dust that is taken by the air?—That is generally in the main road, of course.

11657. And further from the face?—Yes.

11658. As the coal goes along the main road, if there is any dust conveyed from the tub, that of course goes on to increase the general stream of dust that is carried on by the air?—Yes.

11659. Have you yourself made any experiments with a view of finding out whether it is necessary to take any

Digitized by Google

steps to get the working place free from dust?—No, I have never done that.

11660. But you have dealt with dust along the roads?—Yes.

11661. What I mean is, it has been your practice to remove the dust?—Yes.

11662. From what part of the mine have you removed it: have you made any attempt to remove it from the face?—No.

11663. You have removed it from the roads—beginning where?—Beginning pretty near to the pit and continuing on.

11664. I am rather speaking of how near the face you have got?—Seldom beyond the shunt or flat.

11665. You have taken it from the highway, so to speak?—Yes.

11666. You have taken means to have your tubs put right, I suppose, also, so that they would be closed tubs, or so that they would shed as little dust as possible?—Well, I always grumble if I find that a tub has got holes in it.

11667. How frequently have you to remove this dust?—I am not making it a constant practice, but if a road gets dusty I move it.

11668. How many times a year do you remove the dust?—Sometimes in a few months, sometimes in a few weeks. It is according to the traffic.

11669. Do you find that in a few weeks a large amount of dust would accumulate?—Not a great amount.

11670. You have no regular rule as to the period at which you remove it?—No.

11671. Who decides? Do you decide yourself when it is time to begin to remove the dust?—The manager of the colliery attends to it, and when I go along the road, if I find it dusty I say to him, "Why do you not clean this road?" That has not been done so much with a view of providing against dust explosions, but it is for the general utility of the working.

11672. Now with reference to the remedy. When you have been speaking about removing and watering, you have been dealing with the whole of the roadways, I suppose?—The main roads.

11673. Yes, the main roads from one end to the other. Have you considered how far the consequences of an explosion might be rendered less disastrous, if it happened, by having protected zones along certain parts of the main roads?—Yes. I have already spoken to that.

11674. With regard to those zones, would you see any objection to leaving it to the manager of the particular pit to say whether he would protect them by removing the dust, or by rendering the dust in those particular zones harmless by means of watering, or by some other means?—That is my point—that I think that should be left to the management. and that it might be done in one way or in another, so long as it was done.

11675. In whichever way it was going to be done, the roads would have to be made suitable for that particular process in that particular area?—Yes.

11676. Now you are in the dark, I believe, as to the distance and the length at which the zones should be placed in order to make them efficacious?—Yes.

11677. Do you know whether that information is available anywhere?—The only thing I have seen is that it is suggested that 50 yards or 100 yards should be the length.

11678. Do you think it is desirable that there should be some general inquiry made with a view of ascertaining with more definiteness the distance at which it would be necessary to place those protected areas, whether they were going to be watered or going to be cleared from dust, or dealt with in any way, in order to make them efficacious for the purpose for which they are to be adopted?—I think it is essential.

11679. You think it is essential that, before any conclusion be come to, more information should be obtained upon those points?—Yes. There is no object in making a place 200 yards long if 100 yards is equally good, or 100 yards long if 50 yards is equally good.

11680. In those protected areas, in whatever way they might be protected, the afterdamp would be serious in the event of an explosion, would it not?—Yes; that is to say, there would be less afterdamp according to the less area which the explosion traversed.

11681. But still, those areas would be no protection against that?—No; only in reducing the total amount of afterdamp.

11681A. (*Dr. Haldane.*) That would be a very important protection, would it not?—Yes, it would.

11682. It would mean a few men killed instead of perhaps 100?—Yes.

11683. (*Mr. Ratcliffe Ellis.*) Do you know pits in the neighbourhood of Manchester which are at very great depths?—Yes.

11684. Not necessarily great depths from the bottom of the shaft, but they go on the slant a considerable distance further?—Yes.

11685. What is the deepest underground that you know of?—It is bordering on 1,300 yards.

11686. Have you ever been down such pits?—Yes.

11687. Is it very hot there?—Very hot.

11688. What would be the effect of watering?—I spoke to the manager of one of those pits a few days ago and he gave me an instance where they let off some impounded water into the lower workings, not a large quantity, but for the time that it took before that water was evaporated he said they practically could not work, and that it was as much as they could do to exist.

11689. Could you state the temperature in the workings?—In the face it was 92 deg. or 93 deg. I believe: it was 86 deg. or 87 deg. in the haulage way.

11690. So that it would be impossible to work down there if watering was carried out?—That is what he said. He said "We could not have gone on if we had had that." Another gentleman who happened to go down during the period said it was as much as he could do to live and do nothing: he wondered how they could do anything at all.

11691. So that that is a case in which watering would be absolutely impracticable?—Yes.

11692. Now with reference to shot-firing; the Regulations as to shot-firing are contained in the Coal Mines Regulation Act, under General Rule 12, and in the Explosives Order?—Yes.

11693. Are you familiar with them or would you like to refer to them?—I should prefer to refer to them because they are rather complicated, and I always make a practice of looking them up on any point that occurs.

11694. What I want to ask you is whether you have anything to suggest in reference to shot-firing in addition to the existing provisions?—I think the ground is very well covered.

11695. Do you think it desirable that, beyond the present conditions, shots should not be fired in the haulage roads except on the direct instructions of the manager or under-manager?—That is so, I think, now.

11696. No, it is that a competent person must fire them: but I ask you beyond that whether you think that, in addition to their being fired by a competent person, the shot should not be fired unless it is ordered by the manager or by the under-manager?—I think it would be rather desirable.

11697. I gather your view is that if we could be assured that there should not be any breach of the Rule with reference to shot-firing, then we might hope for much greater safety even in dry and dusty mines?—The Rule is that "shots shall not be fired on main haulage or main intake or main haulage roads except with the special permission in writing of the certificated manager."

11698. That is the special Rule in Lancashire?—Yes.

11699. That is a little in advance: but what I ask you is whether you think that a Rule of that sort should be made a General Rule?—I think it would tend to safety.

11700. Have you found that Rule at all oppressive or difficult to work in Lancashire?—No.

11701. (*Mr. Wm. Abraham.*) I think you said you have had experience of dry and dusty mines?—Yes.

11702. How dry?—Well, so dry that there is no water of any kind about unless you take it there.

11703. You speak in your evidence of having always got the natural mine water to flow in defined channels. You know of mines which have no water to flow?—Yes

11704. Do you consider mines which have water to flow are dry and dusty mines?—They might be.

11705. But do you consider them so?—Parts of those mines would be dry and dusty unless the mine was

Digitized by Google

Mr. G. H. Hollingworth.

6 Feb. 1907.

naturally wet. Of course, you may have a great deal of water that is really not made in the general working of the mine, but it may be in the colliery.

11706. How often would you consider it necessary in a dry and dusty mine to clear the roads of the dust laying thereon?—That would be simply a question of how fast it would accumulate.

11707. How many inches in a yard would you allow to accumulate before you considered it to be dangerous?—Do you mean how many inches in a square yard, or how many inches thick?

11708. How many inches thick: how much do you think should lay there?—I should think it was time to get it away before it got an inch thick.

11709. Then you would have cleared your road six times before you would have had 6 ins. of dust on it if it had not been cleared?—Yes.

11710. In your view, in order to adopt the plan of clearing the roadways from dust so as to make them safe, even an inch of dust should not be allowed to lay on the road?—I think so.

11711. Do you think that is practicable?—To get it down to an inch?

11712. Yes?—I think it is practicable to get it down below an inch.

11713. I think you have had experience of very deep mines. There the atmosphere is very hot?—Yes.

11714. Have you much dust in those mines?—Yes, there is just the same tendency to dust there as in other mines.

11715. Is there not more?—No, not in the haulage roads; there is no special reason why there should be more.

11716. The dryness of the atmosphere would not be a reason that there should be more dust on the roads?—No, I do not think it goes to so fine a point as that.

11717. Then its being warm is not a danger?—Not in that sense. You may have a perfectly dry mine at 50° or 60°.

11718. But compare that with one at 90°: which would you consider the safer?—I do not know that the question arises. Of course, when you get up to 90°, if there is any moisture whatever in a seam it is licked up by the air.

11719. Hence it does not matter, upon the question of safety of the mine, whether it is 60° or 100°?—Not on that particular point.

11720. Very well, I am glad to hear that?—The question of temperature might come in in another way.

11721. Let us see what that is: do you mean to increase the danger?—Yes, it might increase the danger.

11722. In what way?—I should say there would be a greater tendency for coal dust to explode in an atmosphere of high temperature than of low temperature.

11723. That is what I was trying to get you to admit just now; but you said "No," as I understood. Then there is a greater danger in that temperature of 90° where there is dust than where there is dust at a temperature of 60°?—I think it is likely. That is a matter for experiment, of course; but I think the tendency is in that direction.

11724. Then, if an explosion is, we will say, ignited by firedamp there, that would be a place where the explosion would extend faster and further than in the lower temperature?—I think that is likely.

11725. Then what would you recommend in those cases, if watering is impossible, to prevent the extension of explosion?—The removal of the dust.

11726. You would have no dust at all lying there?—That is so. That is to say, you would keep it down within the explosive limits.

11727. How often would you have your timber and your roof swept of the still more dangerous dust?—That would entirely depend upon the accumulations. I should have it swept in a regular, systematic way, so as to keep the quantity of dust down below the explosive limit.

11728. Are you prepared to advocate—because that is what we are doing here—legislation providing that all dry and dusty mines should be kept in that condition—that, so far as possible, no amount of dangerous dust should be allowed to lay either on the floor or on the sides or on the roof?—What I want to advocate is that you should get your safety in as little onerous a way as possible: that in some cases watering might be all right, and in some cases the removal of the dust might be the right means, and so on. There are various ways of taking precautions, according to the danger, and you want to adopt those methods.

11729. Yes; but you are a practical mining engineer, and we are now enquiring as to points of safety. Any man could give us a general answer. In your opinion, as a practical mining engineer, what is to be done in cases where you say watering is too dangerous to be effective?—Remove the dust. In the first place prevent its accumulation as much as possible, and then remove the remainder.

11730. Now, how is that to be done? I am seeking for information, because I come from a district in which the mines are dusty, and in which dust of the most dangerous character is allowed to accumulate. Can you suggest a mode of making those roads dangerless?—The methods of minimising the production of dust have already been placed before you.

11731. If you have answered that question to the Chairman, of course I do not wish to go into it further?—One of the principal sources of dust, of course, is the escape of it from tubs, both by being blown off and coming through holes in the tubs. That part which comes through holes in the tubs can be avoided by having tight tubs, either by construction or by keeping them in proper repair. That part which is blown off the top of course must be dealt with by moving, but it can be prevented to a certain extent by spraying the tops of the tubs—wetting the tops of the tubs.

11732. (*Mr. Smillie.*) In your statement you say that the spraying would be expensive. Do you mean it would be inexpensive in most cases, or expensive?—It would be expensive. If you have to take your pipes from your pit a mile or two in-bye, it becomes expensive, but no doubt it would be effective for the purpose of settling the fine dust.

11733. (*Mr. Wm. Abraham.*) Have you in your mind, as a mining engineer, any definite plan to prevent an explosion expanding once it has taken place?—So far as dust explosion is concerned, by removing the dust.

11734. Your idea is to keep the mine dustless?—Yes.

11735. (*Mr. Cunynghame.*) I should like to ask you whether you would consider that a mine had been properly dusted—dust removed—if as much as a layer one inch thick still remained there?—No.

11736. How thick would you say the layer might remain—because I gathered that according to you there would be often one inch, and that even if the mine were dusted there would be often an inch of coal dust?—No, I think that it should be removed in a systematic way, that is, that you should have certain men told off to clean the roads continually, and that you should have sufficient men to clear the dust away before it accumulated to that thickness.

11737. Would you consider a tenth of an inch dangerous?—I should consider you were getting very near to safety if you got to that.

11738. You will see the reason of my question. Would you consider a quarter of an inch unsafe?—I do not think a quarter of an inch would do very much harm in a large road.

11739. I mean a quarter of an inch of dust over the timbers of the roof, for instance?—I think you might easily keep it down very much below a quarter of an inch on the timbers.

11740. Never mind what you might keep it to. I ask what you think would be unsafe?—I should not allow a quarter of an inch to accumulate on the timbers.

11741. Then how would you manage to sweep dusty mines so as to keep the dust down to a quarter of an inch?—It would be regular employment for somebody.

11742. It would require to be done every half hour in some cases, would it not?—No.

11743. How often do you think it would require to be done?—I really could not say. It depends upon the amount of traffic.

11744. (*Chairman.*) I have not asked you about screens. It has been suggested that screens ought not to be very near the downcast pit, but that you should place the screens at a distance from the downcast pit. Do you think that is necessary or desirable?—It is, I think, very desirable.

11745. That is to say, where it could be done, I suppose; but in many collieries they have not the room to do that?—That is so.

11746. But in new collieries would you consider that the screens should be placed at a distance from the downcast shaft of, say, 100 yards?—I should not fix the position

Digitized by Google

exactly, but I think they should be put in such a position that the dust is not likely to get down the downcast shaft.

11747. (*Mr. F. L. Davis.*) Your point, I understand, is that you first of all must prevent the dust from accumulating ?—That is so—as much as possible.

11748. Is there any particular pit in your district that you have the sole management of, or that you are interested in and consulted specially for ?—Yes.

11749. You advise for a good many mines, I believe, do you not ?—I have two collieries under my control, you may say: they are not large collieries.

11750. What is the kind of tub that is used there ?—The ordinary wooden tub.

11751. Closed at both ends ?—Closed at both ends.

11752. That kind of tub, if it is kept in proper repair, would be about the best kind of tub for preventing the small coal and dust dropping out ?—If it is kept in proper repair of course it does prevent that; and it is only then a question of what goes over the top.

11753. I think the Chairman asked you with regard to the small coal or dust on the top of those tubs. Is it not a fact that there is practically very little small coal or dust ever put on top of the tubs ?—No, not with us.

11754. With us it is so. Do you consider that as those tubs are passing down the main haulage road against the air current there is very much of that dust blown away ?—I do not think the bulk of it is very much.

11755. It is too coarse a dust to be blown away as it travels, is it not ?—Yes; but the very fine part of it is, of course, the part that gets blown off. What I mean is that the weight that is blown off in a day's working is not very great.

11756. With regard to these dust explosions of which we have been talking this morning, nothing has been said at all about the amount of ventilation there is, and what effect that may have on an explosion. Is it not the fact that the quantity of air going through has a good deal to do with the spread of an explosion once it takes place ?—Yes, that must be so—the supply of oxygen.

11757. I mean we have heard a good deal from Mr. Cunynghame about the amount of dust, but nothing about whether it is dust in an air current of such a volume, or whether it may be dust in an air current of a much greater volume. I put it to you that that would have a great deal of effect upon the spread of an explosion ?—Yes, that is what I understood the point was—that so much dust to the cubic yard is necessary to cause or to continue an explosion, and, of course, the greater the number of cubic yards you have to a certain proportion of dust the more attenuated the matter is.

11758. You have told us that you have been very fortunate (and I must congratulate you) upon having no experience practically with regard to explosions ?—Yes.

11759. But do you know of your own knowledge of any explosions that have taken place from natural causes; I mean an explosion taking place without a shot being fired, or without a man being in a mine ?—I have heard of one, I think, in Staffordshire, which took place when there was nobody at all down the pit; but I have no knowledge of the details of that.

11760. You have never had any experience in your own collieries ?—No.

11761. I understand from paragraph 7 of your statement that you want information on all these points: what kinds of dust especially are explosive, how much watering is required, the effect of temperature, and so on, and the effect of velocity of air current ?—Yes.

11762. With regard to all those matters, you think there should be some definite knowledge before any conditions are made compulsory by Act of Parliament with regard to watering ?—That is my view.

11763. In the case of a mine which you told us about, which had a great quantity of water that you had to deal with and carry off, that was, I suppose, a spring, was it not, or in the nature of a spring ?—I do not quite understand you, because I did not mention any place.

11764. You mentioned a mine in which you had a great quantity of water to deal with, where you had a channel cut in the side of your road to carry it off ?—It is not a great quantity of water.

11765. Mr. Cunynghame rather suggested it was a great quantity of water ?—Well, 15 or 20 gallons a minute is not a great quantity to deal with.

11766. I put it to you, is that a case in which water appeared within a very small space—more in the nature of a spring ?—In this case the strata are generally damp; there is a rock above the coal, and it gives the water off in springs in that way in various places. But the instance which I gave of the road was a case in which it is an absolute rock roof, and drops, and the water gradually accumulates, and is making its way towards the shaft; it is in no defined channel, but has got into the floor.

11767. I will put it in this way: it is quite possible to have such things in one portion of the mine and for the whole of the rest of the mine to be dry and dusty ?—That is so. That is what I meant by my answer to Mr. Cunynghame.

11768. You state that you think the Act of Parliament and all your Special Rules and the General Rules are very carefully carried out in your district ?—Yes.

11769. And that possibly that may be the reason for the freedom from explosions in your district ?—Yes.

11770. You have referred to Wales: I have no fault to find with you because you are pleased with your own district, but has it occurred to you that possibly because the accidents are more frequent in Wales the natural causes may have something to do with it ?—Yes. What I should have said about it in other respects ended at that, because I have no real knowledge of the conditions of mines in Wales. I know, of course, that some of their dusts are specially explosive—that is one point.

11771. And that generally speaking there is more gas given off in mines in Wales ?—Yes; and that you have considerable difficulties with your roofs.

11772. (*Mr. Smillie.*) I suppose we may take it that you are not concerned so much about the commercial aspect of this question as you are with regard to the safety of the workmen ?—Yes, I have come here really as representing management, and it is the discipline and working of the mine that I have given special attention to in my evidence.

11773. You really begin by referring to the commercial side of the question, that is cost ?—Of course no colliery could be worked unless when the colliery owner started there was a prospect of making money. The question of cost is the root cause of everything. You can get safety by closing the colliery.

11774. But you are aware that this Commission is sitting in the interests of safety, and that it is not concerned so much with the question of cost as it is with the question of safety ?—Yes; but you cannot ever lose sight of cost in these matters.

11775. I suppose you would not care to put it at what price per ton you would think human life would be placed at ?—No.

11776. You gave some figures, I think, from Germany, as to the cost of watering there, which figures were approximate ?—The figures are given to me in the Appendix to Mr. Atkinson's evidence.

11777. I think the figure you quoted was 1½d. per ton for the cost of watering ?—Yes, that is the cost of watering given in the Hibernia Colliery.

11778. Does that not mean the watering of the whole of the main roads of the mine ?—Yes; complying with the Rules.

11779. Not zones, but the whole ?—Yes.

11780. Supposing it were proposed to have watered zones of 100 yards, that would reduce very considerably the cost below 1½d. per ton ?—Yes, for the watering.

11781. I am coming to the other point ?—But it would not reduce it proportionately.

11782. No, certainly not, because you would have to take your water there ?—You would have to have installations for your water pipes.

11783. You ventured an opinion—not very definite, I admit—that the cost of the upkeep of the roads, because of the heaving of the pavement, might come to 1½d. per ton more ?—I think it would probably come to that, or more, in almost every case.

11784. A total of 3d. per ton: 1½d. for the watering and 1½d. for the extra upkeep ?—Yes: that figure is a minimum, I should think.

11785. That also referred to the watering of the whole roads and the heaving of the whole roads because of watering ?—Yes.

11786. Supposing we take that figure as correct, I think you said there were 7,000 yards of roadways in the mine which you had in your mind ?—Yes.

Digitized by Google

Mr. G. H. Hollingworth.

6 Feb. 1907.

11787. Supposing that you watered in zones instead of watering the whole, and that that reduced the amount of roads which you watered to one-tenth of your 7,000 yards, would not that reduce the extra cost very considerably?—It would reduce the extra cost very considerably.

11788. There would not be a large cost for repair or upkeep of, say, four or six zones in a mine such as that. What I mean is that the damage to the roadways, presuming there would be damage, by the watering, would be only to the 100 yards zone, and perhaps a little bit on each side of it?—Yes, that is so.

11789. Then the cost would not be so great?—The cost would not go up anything like in proportion.

11790. You say that in your experience of 40 or 50 mines there is only one mine in which you would say it would be safe to water—to drench the mine—because of the fact that there is a rock roof and a rock bottom, a rock pavement?—Yes.

11791. There are other roofs which would not be affected by watering: there are other strata which would not be affected, which is not called rock?—We have none in our district. Sandstone is the only one that would not be affected by watering that I am aware of.

11792. There are no other strata that would stand the water but the rock, without being injured, you say?—Yes.

11793. Do you know whether or not the Courrières mines were wet mines—damp mines—or very dry mines?—I do not know, as a matter of fact, I only know from the Reports I have read upon it.

11794. Do you know whether there is anything in the Report that would indicate whether they are wet?—There are passages in which the Report speaks of the explosion having reached a wet place and stopped there; but, generally speaking, I believe they are not what we describe as wet mines.

11795. Are you aware that the South Wales mines are not generally very wet mines in the sense that you are speaking of?—Yes, I gather that.

11796. Are you aware that the accident rate from falls in South Wales is very large in proportion to other parts of the country?—Yes.

11797. Will you tell me how that agrees with your statement that there would be more accidents and that there are more accidents in wet mines than in dry mines?—The other conditions, of course, are against them.

11798. The nature of the roof and sides?—The nature of the roof, and so on.

11799. The nature of the workings?—Yes.

11800. That is the only reason you could give for the raising of the accident rate there?—That is so. It is generally understood that they are difficult mines in that respect in South Wales.

11801. In the event of the Government ultimately dealing with the question of removing coal dust, would you be satisfied with a Rule dealing with dust such as Rule 1 dealing with ventilation—"An adequate amount of sweeping shall always take place to render dust harmless." Do you think that would be sufficient?—What I should advocate would be, if possible, giving different ways of dealing with the matter, and to make it compulsory that it is to be made harmless by some means or other, by removing dust, or watering, or giving people the chance to use some other means.

11802. But you yourself favour the method of removal of the dust?—Yes.

11803. Even to the extent of removing it along the whole of the roadways and keeping the roadways clean?—Yes; the haulage roads.

11804. But that would not be done unless there is some provision made in an Act of Parliament for having it done?—Yes, but you might give other people an alternative who had not the same opinions upon it that I have.

11805. I am now dealing with the removal of dust in the event of that being the recommendation or being made law?—Yes.

11806. Do you think a clause would be sufficient which said "An adequate amount of sweeping or cleaning shall always take place to render the dust harmless"?—Yes, I should be satisfied with that, personally.

11807. Would that be effective, do you think?—I think so.

11808. Would not a question then arise as to when the dust was removed sufficiently well to render it harmless?—Yes. I have been saying that all through—that I want to know how little dust or how much dust can be allowed before it is harmless.

11809. I suppose the same thing would apply to watering, unless it was clearly laid down to what extent and to what degree the watering should take place?—Yes. I think it is not necessary to have a place kept thoroughly wet if damping it is equally efficient.

11810. In regard to the figures you dealt with as to the percentage of accidents, did that percentage mean all the accidents from falls of roof and sides or only those in the main roads?—Only those in the main roads.

11811. (*Dr. Haldane.*) I should like to ask you whether you have ever examined carefully a mine or any part of a mine in which systematic watering was carried on on the roads?—Not carefully. I have seen very little of systematic watering. I have known two or three instances where it has been carried on to some extent.

11812. It was said in Germany that sometimes damage was done at first which did not continue afterwards—when watering was first introduced?—My experience is that it is always harmful to water—that damage is always done.

11813. But your experience is derived from observation of naturally wet places in a mine?—Yes.

11814. Can you not conceive that it might be very different in the case of artificial watering which is put on from the roadway itself?—Yes; that is entirely a question of how much you put on, really.

11815. So they told us in Germany—that if you put on a great deal it did damage, but on the other hand the general experience there seemed to be that there was very little damage?—If you could stop your watering just at the point when it had saturated the coal dust, and touch nothing else, then your roads would not be damaged.

11816. But they certainly go further than that, so far as I could judge looking at the roads?—As soon as you begin to get an extra quantity of water you touch up your strata.

11817. But they seemed in the great majority of cases to be able to keep the whole of the roads damp and yet not to cause such trouble as they complained of, at any rate from the floor, roof and sides?—Well, that is not making it wet—that is making it damp.

11818. As regards the action of heat on the men, first of all you have said that you thought probably the men suffered more from rheumatism when the mine was wet?—Yes.

11819. In the cases of mines with regard to which you made that observation, was not the seam a shallow one where the temperature was low?—Where you have water, as a rule, of course the temperature is lower than dry mines of the same depth.

11820. They are usually shallow mines as a general rule, are they not?—Yes: of course that would have an effect, but you probably would not get the rheumatism if the mine were dry. I am speaking more particularly of men who are working in water to a great extent, and then if you have the whole of your mine wet it would be a dirty mess altogether, and everybody would have wet feet the whole of the day.

11821. I will put to you a case which I am familiar with, namely, that of the Cornish miners: they are the whole time, as a general rule, in very damp and wet mines, but they are also warm mines, as a rule. I never heard of their complaining of rheumatism especially?—It may be that what you say is correct, that it is due to the low temperature combined with the dampness.

11822. It may have to do with it, perhaps. With regard to the instance of the very deep mine which you gave in which the temperature was 92° at the face, I think?—92° or 93°.

11823. And it was found that when a large amount of water was present it was impossible to work: I should like to ask you whether the air in which that observation was made was stagnant at the time, or whether there was a good air current?—There was a good air current going in parts, and of course there was an air current going round the faces; but the remarks which were made applied to the case where there was a good air current.

11824. And the air there was saturated, or nearly saturated—very moist—was it not?—It was licking up the water that was there, and of course it might be saturated at some time.

Digitized by Google

11825. That rather puzzles me, because there is no doubt, as you are aware, that the effect of evaporating water in a deep mine is to cool the air?—Yes.

11826. A spray has a very large cooling effect, has it not?—Yes, evaporation does usually result in cooling.

11827. At that high temperature it has an enormous effect, as I think can be seen if one calculates it; the cooling effect is very large?—Yes.

11828. It is a little puzzling to me to know how, unless the air was actually stagnant, that high temperature was maintained with a great deal of evaporation going on?—You see there were no scientific observations taken; it was simply that the manager of this place said that they could not have continued, and that it was awful during the week or two that they had this on.

11829. I am quite sure he was correct as to its being absolutely impossible to work in an atmosphere of 90° in saturated air, or even in 80°.—It was 80°, I should think, in the main roads, and it got up to 90° odd against the coal face.

11830. I should have thought it would be almost necessary to use water sprays and things of that kind in very deep mines to keep down the temperature?—I always understood that one could more comfortably stand a very considerable amount of dry heat.

11831. Yes, there is no doubt whatever about that, I think, but the effect of the evaporation of moisture is to reduce the temperature so much that you gain very often?—Yes, you gain on temperature, but you lose on the other.

11832. You lose in one way but you gain in the other, and on the whole you gain, I think—you bring down the wet bulb temperature, which is the important matter?—But in this case they did not gain, because they got to breaking point with the water, and as soon as the water had gone they would get to normal conditions again.

11833. Have you ever considered what arrangement would be best for an experimental gallery, such as you think should be recommended?—I have not.

11834. You have not considered, for instance, whether an old mine or part of an old mine would be suitable for the purpose of such experiments?—I do not know. I should not like to be about when those experiments were going on.

11835. I am afraid it would be an expensive matter in any case?—Yes. There was an experimental pit in Lancashire where they fired the cannons up the pit, but it is one of those matters with regard to which I would rather be behind a fortification.

11836. Still, you agree that it is very necessary to carry out these experiments?—It is very necessary to carry out something of the sort to acquire real knowledge.

11837. And that it would be necessary to have a long gallery in order to test the influence of dustless or wet zones?—Yes.

Mr. Isaac Hodges, called and examined.

STATEMENT OF WITNESS.

Coal Dust and Watering.

11837A. (1) I consider it impossible to classify dusty from non-dusty mines, as it is not so much a question of the quantity of dust as of inflammability, according to the amount of carbonaceous matter and the admixtures of fireclay and shale dusts, as also the percentage of moisture contained therein.

(2) The explosive dust consists solely of finely-ground pure coal dust. I believe it possible that an explosion of this finely-ground pure coal dust may arise without the addition of firedamp, but a small percentage of firedamp greatly increases the chance of igniting. The most inflammable dust cannot be exploded with a naked light, in the absence of firedamp, unless the dust is violently disturbed and thoroughly mixed with the air current. The detonation resulting from shot-firing largely increases the chance of ignition.

(3) The most explosive dust in a mine is found on the sides and roof of the underground haulage roadways, particularly that dust contained in the crevices and cracks of the old packs, and in the porches and roads adjoining the shaft where the fine dust from the screens on the surface has been deposited by the intake air current. The coal dust at the working faces in the Yorkshire Coalfield is not explosive.

(4) The explosive dust principally comes from the finer portions of the dust blown from the loaded pit-tubs during their mechanical haulage from the working faces to the shaft against the high velocity of the in-going air currents, particularly in high-speed haulage roads, and from the larger portions of coal lost from badly constructed pit-tubs, which is afterwards ground by haulage and walking into fine dust; from the continuous grinding up of the thin coal seams in the roof and sides of underground roads; and that brought down the pit from the screens at the surface. In my opinion, no appreciable amount of dust can get from the working faces to the haulage roads, as the air currents are directed towards the working faces from the haulage roads.

(5) The accumulation of explosive dust may be largely remedied by improving the type of pit-tubs, so as to carry all the coal from the working faces to the surface without losing any during transit. A very small percentage of dust is blown from the top of the tubs as compared with the dust leaking through the crevices of the timber framework, as, generally speaking, the miner first fills the body of the tub with small coal and then tops up with large; therefore, the small is largely shielded from the velocity of the air current during haulage. In the Whitwood Silkstone Mine, 420 yards deep, having working faces at a radius of two miles from the shaft, a marked improvement has been effected in the condition of the haulage roads by replacing the rolling-stock. I designed a steel pit-tub which was perfectly dust tight; this was objected to by the miners, and caused considerable friction, and it was eventually replaced by a new design having a steel bottom and grooved and iron-tongued side and end boards, which has now been adopted as the standard type for the pit. This tub has been described to your Commission by Mr. Walker, H.M. Inspector of Mines for Yorkshire, and a model will be exhibited to the Commission. The explosive dust caused by the grinding of the thin coal seams in the sides and roof of the roadways can only be removed by continuous cleaning. The dust from the surface can be best guarded against in the newer and larger mines by removing the screens to some distance from the pit-top, and providing a separate building, without connection with the pit-top except by gangways necessary for the pit-tubs, which should be left uncovered, and arranged so as to allow the prevailing winds to blow the dust away from the downcast. The spraying of the full pit-tubs at the working face before commencing the haulage journey would be of little value in preventing dust, and would seriously deteriorate some coals, and always cause trouble in the screens.

(6) The conditions of the underground roadways in the various seams and pits vary so much that it is not possible to establish a system of complete watering. Attempts have from time to time been made to water the main haulage roads of the deeper seams at the Whitwood Collieries with the result that the upkeep of the roads increased enormously, and the practice has had to be discontinued. Merely damping the roads had no lasting effect, and heavy watering caused the floor to heave, and the sides and roof to fall so as to be a continual source of danger. Watering is now used solely for the purpose of laying dust so as to render it easier to fill into pit tubs and send out of the pit: during the filling out, thoroughly wet canvas sheets are hung at certain distances to prevent dust passing out of the section that is being cleaned. In the Whitwood Silkstone Seam, which is naturally dry, a little water found in the floor caused the road to "work" so much, that 20 ft. of ripping had to be taken to put the road above the effects of the water, and this effect would have been continuous so long as water had been applied.

(7) To render fine coal dust inexplosive, the whole of the roof and sides must be wet, and watering of the floor only would not be satisfactory.

(8) For the purpose of concentration the Whitwood Colliery Company has connected their seams and pits over an area of about 5,000 acres, and, following the disastrous effects of "Courrières," it has been decided to sectionise each district of each seam from the main haulage roads and from the upcast and downcast pits with a length of brick arching, or brick walls and girders with concrete roof, and concrete floors to be kept continuously free from dust by frequent cleaning and white-washing, or

Digitized by Google

Mr. I. Hodges

6 Feb. 1907.

by constant watering as may afterwards be decided. At each pit bottom the arching will be 150 yards long in each direction, except at the central winding shaft where the arching will extend 300 yards in each direction—North, South and West, for both full and empty roads, which for this winding shaft alone will involve about ¾ mile of arching. I was at the Blackwell Colliery, Derbyshire, at the time of the explosion, and that explosion proved to me that a length of about 150 yards of brickwork free from dust stopped the explosion and kept the winding shaft and plant intact. Although the explosion was of great force, it was stopped in its main direction by the clean length of arching, and turned round from the arching and traversed another main haulage roadway for a further distance of 1,100 yards. Attempts have been made at the Whitwood Collieries to collect the dust from underground roadways by a large air pump on the principle of the vacuum cleaner, sucking the dust from the timbers and packs, filtering and depositing in closed pit tubs for removal, but the progress was so slow as to be quite useless in keeping any considerable length of roadway free from dust. It was also found impossible to extract the dust from the crevices and cracks of the packs, but such an air pump would be useful for keeping smooth lengths of archway free from dust to sectionise the effect of explosion.

(9) At the Whitwood Collieries, the length of main haulage roads is 35,000 yards, and in addition there are 12,500 yards of horse haulage roads, excluding all horse roads within 100 yards of the coal face. (See Explosives in Coal Mines Order). It is impossible to estimate the cost of effectually watering the Whitwood Mines, as the cost of installation and upkeep and the charge for water would be only minor costs in comparison with the cost of keeping roadways open subjected to constant "creep" and lessening in sectional area. The continuously wet state of the roads would be dangerous from the more frequent falls of roof and sides and result in accidents in haulage, and would be generally inconvenient and tend to a lessened condition of efficiency and health. Workmen choose the deeper seams because of the even temperature and dry nature of the work, and the saturated roadways would bring back the old conditions of the shallow mines when miners were subject to rheumatism owing to walking and working in wet clothes. In the Whitwood Collieries to-day the seams up to 150 yards deep are wet, and the workmen therein are considerably disadvantaged by the wet nature of the work, wet clothes, and lose in general health.

(10) The addition of salt to water has proved to have a marked effect in laying the dust on the floor of roadways before filling into pit tubs, so much so that the briny water from the Whitwood Haigh Moor rock is carried to the deeper seams in preference to ordinary river water. It cakes the dust, sets the floor hard, and greatly improves the roadway.

(11) Referring to the suggestion that shot-firing should be prohibited unless all the workmen were removed from the seam and from all seams communicating with the shaft at the same level, except those necessarily engaged in the seam for all purposes (not exceeding 10) as specified in General Rule 12, this would be prohibitive at the Whitwood Collieries as during 1906, 68,000 shots were fired, nearly all during the working shift. Each of these shots was fired singly and each shot was proportioned to the amount of work to be done, which could only be ascertained by observing the result of the previous shot. After each shot was fired, the roof was inspected and timber set to remedy any deficiency. With shot-firing in the absence of the miner, the danger would be very seriously increased as the roof must remain unsupported for a considerable period and would be very treacherous when the miner returned to work, and frequently the working face would be fallen in. In my opinion, the principal cause of past coal dust explosions has been shot-firing in main intake haulage roads, and as the danger of such shots is now well known, they should only be allowed by written permission of the manager for each shot, who should have personally viewed the conditions and satisfied himself as to the measures to be taken for the safety of the men. Such shots might be restricted to a period when the regular workmen were absent from the mine.

11838. (*Chairman.*) I see that you are a Mining Engineer and a Colliery Manager who has had 25 years practical experience in Derbyshire and Yorkshire?—Yes.

11839. Has your experience been entirely confined to Derbyshire and Yorkshire?—No, I have been engaged in South Africa for three years in gold mining and coal mining.

11840. With regard to your experience in the United Kingdom, it has been confined to Derbyshire and Yorkshire?—Yes.

11841. You are General Mine Manager and Engineer for Henry Briggs, Son & Co., Ltd., Whitwood Collieries, Normanton, having six winding-shafts with an output of upwards of one million tons per annum, and working thick and thin seams of coal varying in depth from 60 to 500 yards, and you are Past President of the Yorkshire Branch of the National Association of Colliery Managers, Vice-President of the Midland Institute of Mining Engineers, and a Fellow of the Geological Society?—Yes.

11842. In the first paragraph of your synopsis you say that you cannot classify dusty from non-dusty mines, as it is not a question of the quantity of dust, but of the inflammability and the percentage of moisture contained therein. What practical test would you apply to a mine to ascertain whether it ought to be treated as a dusty mine or not?—I am afraid there is no practical test to differentiate between a dusty and a non-dusty mine.

11843. Whenever there is dust in any mine mixed up with particles of coal dust, you must treat it as a dusty mine for the purposes of safety?—You may have roads with a very large quantity of dust which may not be inflammable, and that you find out by experience. It would depend upon whether there was a large mixture of shale dust in amongst the coal dust.

11844. Have you gone into the question of how much shale must be mixed up with the most inflammable coal dust to make it non-inflammable?—I have not made experiments, but I have a general practical knowledge that in explosions the explosion does not always traverse the road that appears to have the most dust upon it. It depends upon the quality of the dust. The returns usually contain a great quantity of dust but have not proved so inflammable as some portions of the intakes, which have a less quantity of dust, but coal dust in a purer state.

11845. For practical purposes whenever you find a mine dry and dusty, in the sense of having a great deal of dust, of whatever nature, you ought to treat it as a dry and dusty mine because it would be impossible to have adequate tests as to whether the dust was or was not inflammable?—I suppose it would be so.

11846. In the second paragraph you say that dust consists solely of finely ground pure coal dust. What is your test of the fineness of the coal dust that must be inflammable?—I have not any knowledge of the particular grading, but I mean the impalpable dust which one finds deposited on the tops of bars on the upper portions of the underground roadways.

11847. You think no coal dust less fine than that would have any effect in propagating an explosion?—I do.

11848. Have you thought that out scientifically. What makes you think that?—I say that because of seeing the effects of an explosion and seeing the points at which the explosion stopped. I was at the Blackwell explosion and after some men had been rescued and the other bodies recovered, I made a careful study of the whole mine with a view to finding out what limited the effects of the explosion, so that in future years I might put some remedial measures into operation. I found that an explosion could not traverse the working faces where the dust was more granular, and that it ceased to distil further gas out of the dust.

11849. That hardly shows that it is the finest dust, or such dust as would settle above the floor that would necessarily produce an explosion. It shows fine dust is more explosive than dust not so fine?—There was plenty of dust to continue the explosion if it had not been the question of fine dust.

11850. How much less fine. Is there much difference?—The difference is quite appreciable at the working face. The dust there is very different from that 200 or 300 yards along the main haulage roads.

11851. You consider that the only dust which in itself is explosive is dust that is so fine that it can settle above the ground?—That is so.

11852. If there was a strong wind or any force to impel the dust you might have less fine dust carried into the air?—This fine dust deposits in the eddies, or shielded portions on the sides and roofs of the roads where the air currents are very much reduced in velocity. All

Digitized by Google

underground roadways are not smooth roadways, they are rough, and this fine dust deposits upon the shielded portions of the road.

11853. I should have thought if you had anything in the nature of a strong air current that much coarser dust would be deposited above the ground than where you have a very slow moving air current which would not take up the dust so much from the ground ?—I have not found that difference.

11854. You think that the fine dust you find in those particular places is always pretty much of the same fineness ?—Yes, I find a difference as to the comparative purity of the coal dust, but as to the fineness I find it much the same.

11855. The most inflammable dust cannot be exploded with a naked light in the absence of firedamp unless the dust is violently disturbed and thoroughly mixed with the air current. I suppose you have in your mind the explosion in the hopper ?—Yes, I have in mind the explosions in screens and hoppers, and the coal dust explosions that have occurred without the presence of firedamp.

11856. You say that if the dust is violently disturbed and thoroughly mixed with the air current that, in your opinion, it might cause an explosion simply by putting a naked light to it ?—I do.

11857. That you consider has been verified by experiment ?—Yes, both by practical experiments in hoppers and screens, and the fact of coal dust explosions in mines.

11858. I think we agree that the detonation resulting from shot-firing largely increases the chance of ignition. You say coal dust at the working faces in the Yorkshire coalfield is not explosive ?—Because it is not yet sufficiently finely divided. It is yet too granular.

11859. There must be a certain amount of very fine dust even at the working faces ?—Not usually. It will vary according to the depth of the seam, but in the seams generally worked there is not sufficient finely divided coal dust to make it explosive at the coal face.

11860. You say there is not sufficient, but have you made experiments to know what amount of fine coal dust would be sufficient to cause an explosion ?—I must return to the point that explosions have failed to traverse the working faces because of want of fuel. Although dust has been there it has not been sufficiently finely divided.

11861. Supposing it occurs from the firing of shots at the working faces. Do you think then that it is certain in these coalfields there would not be enough fine coal dust to propagate an explosion ?—We have had explosions of firedamp in the working faces, but they have been merely local explosions. We have not had them traversing the mine.

11862. You have not had an explosion carried any distance by coal dust from the face ?—I do not know of one.

11863. You have had experience of a great many of these Yorkshire mines ?—Yes, I have.

11864. In Paragraph 4 you talk about badly-constructed pit-tubs. I suppose you would say that all tubs should be made as dust-tight as possible ?—Certainly.

11865. How about filling the tubs. Do you think that there ought to be a general rule prohibiting loading the tubs above the sides ?—I am afraid that would be very difficult to enforce. It depends upon many matters. It depends very much in thin seams upon the impossibility of getting a large tub in the face, the small tub is frequently filled up afterwards when it reaches the gate by large coal brought from the face to top it up. In the case of a haulage breakdown the shortage of tubs will cause the miner to put more coal on the tub for the time being, so as to get more output for the day.

11866. You think that it would be impossible to enforce a rule ?—Very difficult.

11867. You do not think that there is sufficient reason why there should be such a rule ?—No. The top coal is always larger coal, and in that sense carries less dust.

11868. It is usually the case, but every now and then a man might fill up the tub with small coal ?—In that case he would not fill above the top, it would run over the sides.

11869. Because it would not stay there ?—Yes.

11870. (*Mr. Enoch Edwards.*) It would not reach his weigh-machine ?—He would lose it on the road.

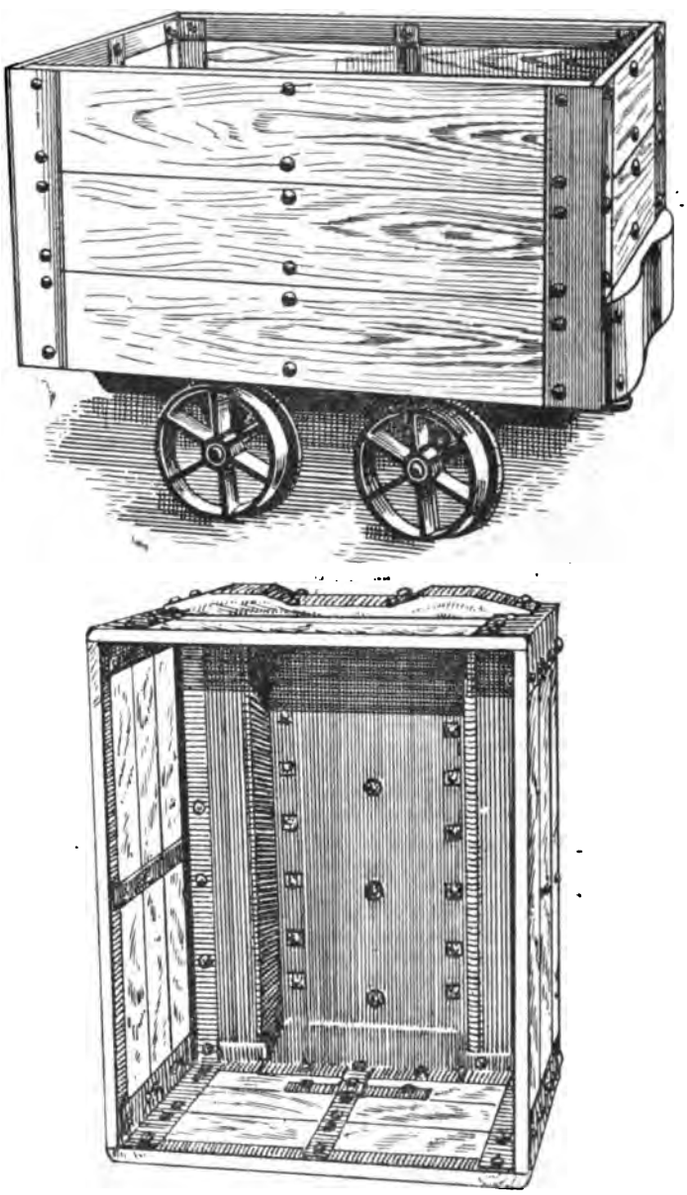
11871. (*Chairman.*) How would you improve the type of pit-tubs. In Paragraph 5 you talk about that. You say that you designed a steel pit-tub which was perfectly dust-tight, but that it was objected to by the miners, and was eventually replaced by a new design having a steel bottom and grooved and iron-tongued side and end boards, which has now been adopted as the standard type of the pit. You are perfectly satisfied with that ?—Yes, we are so satisfied that we are building 2,500 of them this year.

11872. You say that you have a model of that ?—Yes, I brought a model because I thought it would be better than a drawing. The miners have a very strong prejudice against the steel tub. One objection they made, was that when they were working in a hot seam the steel was very cold to their body when they touched it.

11873. I should have thought that it would be hot to their body ?—I never found a great deal of reason in their objections: there was a great deal of prejudice, and considerable friction occurred.

11874. (*Mr. Ratcliffe Ellis.*) What about the additional weight ?—5½ cwt. to 6 cwt. is the tare.

(*The Witness produced a model tub and explained it to the Commissioners.*)



11875. (*Chairman.*) I asked one witness about tubs having flaps so that the men could load the coal more easily: I mean by having a flap here (*indicating*) which could be put up when the tub was filled. Do you think that is a good thing ?—We have tried that, but it does not work successfully. Frequently the miners do not take the trouble to put up the flap.

11876. You get the dust shaken out too ?—Yes.

11877. You think it best to have a tub that does not take down ?—Yes, this is made absolutely dust-tight, so that whatever coal is put in at the working face comes out to the surface. You can keep the tub tight because as the board shrinks and becomes smaller there is sufficient margin in the iron tongue to keep it dust-tight.

Digitized by Google

Mr. I. Hodges

6 Feb. 1907.

11878. You can keep it dust-tight for a considerable time ?—Yes.

11879. (*Mr. Ratcliffe Ellis.*) What is the cost of these ?—These tubs cost £4 each.

11880. Do they last longer than the others ?—I think they will.

11881. (*Chairman.*) What does the ordinary tub cost ?—The difference will be fully £1. This tub carries 12 cwt., and I have agreed with the miners that the tare shall not exceed 5½ cwt. The tub is built similar to a railway wagon and is of much stronger construction than usual.

11882. You believe and hope that the new tub will last longer, so that in the long run it will be less expensive than the old tub ?—Yes, and I think it tends towards safety from the point of view of dust explosion—that is the principal object.

11883. Also you do away to some extent with the necessity of dealing with the dust ?—That is so.

11884. I see that at the end of Paragraph 5 you object to spraying the full pit tubs at the working face before beginning the haulage journey ?—I think for house coal that would seriously injure the coal.

11885. That depends upon the class of coal ?—Yes, very much upon the class of coal.

11886. I suppose that it would prevent an accumulation of coal dust to a very great extent on the haulage roads ?—I do not think so. I think that it is better, and I prefer, to have a tub that would hold the dust rather than have the spraying of an imperfectly made tub.

11887. In Paragraph 6 I see you say that it is not possible to establish a system of complete watering, and then you say that attempts have been made and the practice has had to be discontinued. Then you go on to say that damping the roads had no lasting effect. Do you mean they have to be re-damped as soon as they get dry again ?—That is so.

11888. How long is the damping ?—It depends greatly upon the amount of dust upon the floor. To damp any depth of dust, I mean two or three inches, the road must be deluged with water.

11889. Cannot you keep the dust constantly damp in such a way that you would never be required to damp two or three inches of dry dust ?—We do not find that. We find, as the water runs on the dust it becomes globular and does not mix with the dust unless there is a large quantity of water, and a large quantity of water affects the roadway so as to produce a worse evil.

11890. You think that there is a continual source of danger and that the floor may be caused to heave and roof to fall. Have you any experience in the number of accidents where this system of watering has taken place and where the mines have been kept comparatively dry ?—I have the practical experiment of a portion of a deep mine which was dry and dusty having water in the floor which we could not take away ; that caused the roads to be very bad indeed, and caused workers in that roadway to be more liable to accidents.

11891. As a matter of fact did you find that accidents were more frequent in those places ?—I could not give statistics of them. The roadways lessened very much in area and there was less room to get about. The floor lifted and put the rails out of joint, and the tubs were very frequently off the road. It was more difficult for haulage and to get about.

11892. So far as statistics go, you have no proof that it was more dangerous ?—No, but I do not think that I should have any difficulty in getting them.

11893. Your strong opinion is that it was more dangerous ?—I am strongly of that opinion.

11894. Watering in your mines is now used solely for the purpose of laying dust so as to render it easier to fill into pit tubs and send out of the pit. That would be your way of getting rid of the dust, collect it and water it so that it could be put into tubs ?—The bulk of it, so that there would be no large collection remaining.

11895. The last witness said he thought that it was not necessary to damp the dust, but that he could just brush it off and collect it in heaps and put it into a receptacle without watering ?—That probably would depend upon the depth. We know that in the shallow seams the dust is easier to deal with.

11896. The best way of dealing with it you think is to water it ?—Certainly, but I am speaking of the deeper seams now. It is better to water, and we hang sheets in the section which we expect to clean to prevent the dust travelling into the mine.

11897. You find a difficulty if you swept the dust away in preventing it going to other parts of the mine ?—That is so.

11898. Then in Paragraph 8 you say that it has been decided to sectionise each district of each seam from the main haulage roads and from the upcast and downcast pits with a length of brick arching or brick walls and girders with concrete roof and concrete floors to be kept continuously free from dust by frequent cleaning and whitewashing, or by constant watering as may afterwards be decided. When you say sectionising each district, do you mean sectionise it by dustless areas by providing dustless zones ?—Yes.

11899. You do not suggest that there should be anything in the nature of a physical obstacle ?—I do not see how that is possible.

11900. An obstacle between the underground workings ?—I do not see how that is possible with a free intake and return and with the haulage roads.

11901. There has been a system explained which is used in one colliery. They have cut off one part of the underground portion of one colliery from that of another by means of doors, and there is this advantage in having a complete cut off, that the firedamp cannot travel. It can, of course, travel through your archways ?—Yes.

11902. With regard to the length of zone required to stop an explosion, you say that the Blackwell explosion proved that a length of about 150 yards of brickwork free from dust stopped the explosion and kept the winding shaft and plant intact. Was that brickwork quite dry ?—Yes. That Blackwell explosion was an object lesson on a large scale showing what length of zone was required. I have a diagram of the explosion which I have prepared (*producing diagrams*).* The explosion occurred here (*indicating*) at this shot hole. This was a shot fired in a main haulage road and a main intake. The shot was largely over-charged. The dust that caused the explosion was dust in a crevice of the road which could not be affected by watering. The explosion commenced here (*indicating*). The people who fired the shot were *here* and were found dead *there*. This was 418 yards from the downcast shaft and on the main haulage road. The main force of the explosion came to the brickwork arching forming the porch to the downcast shaft *there* and would have travelled forward to the pit and wrecked the winding gear, but it could not pass the clean length of arching because of the absence of dust. It was checked *there*, and turned round at an angle of 130° and traversed another district where there were no men, producing great devastation. It passed that short length of arching (*indicating*), but it could not pass *that long length of arching*. No damage resulted there, the tubs were not broken, and there was only one glass lamp broken, and the men sitting in the lamp cabin were uninjured.

11903. (*Mr. Ratcliffe Ellis.*) Do you think that would have been the case if there had not been another road there ?—I think so. This road went through to the return and the explosion blew three doors out. It could not travel through to the return because the dust there was not inflammable.

11904. Supposing there had not been those roads it would have gone further along ?—The force of the explosion but not the flame, because it had nothing further to feed upon. The blue book of the Blackwell Explosion has the other diagrams.†

11905. (*Chairman.*) Where did the dustless zone begin ?—At the arching.

11906. All that was dustless ?—From *here* to *here* (*indicating*).

11907-8. How long was the short length of arching ?—40 ft.

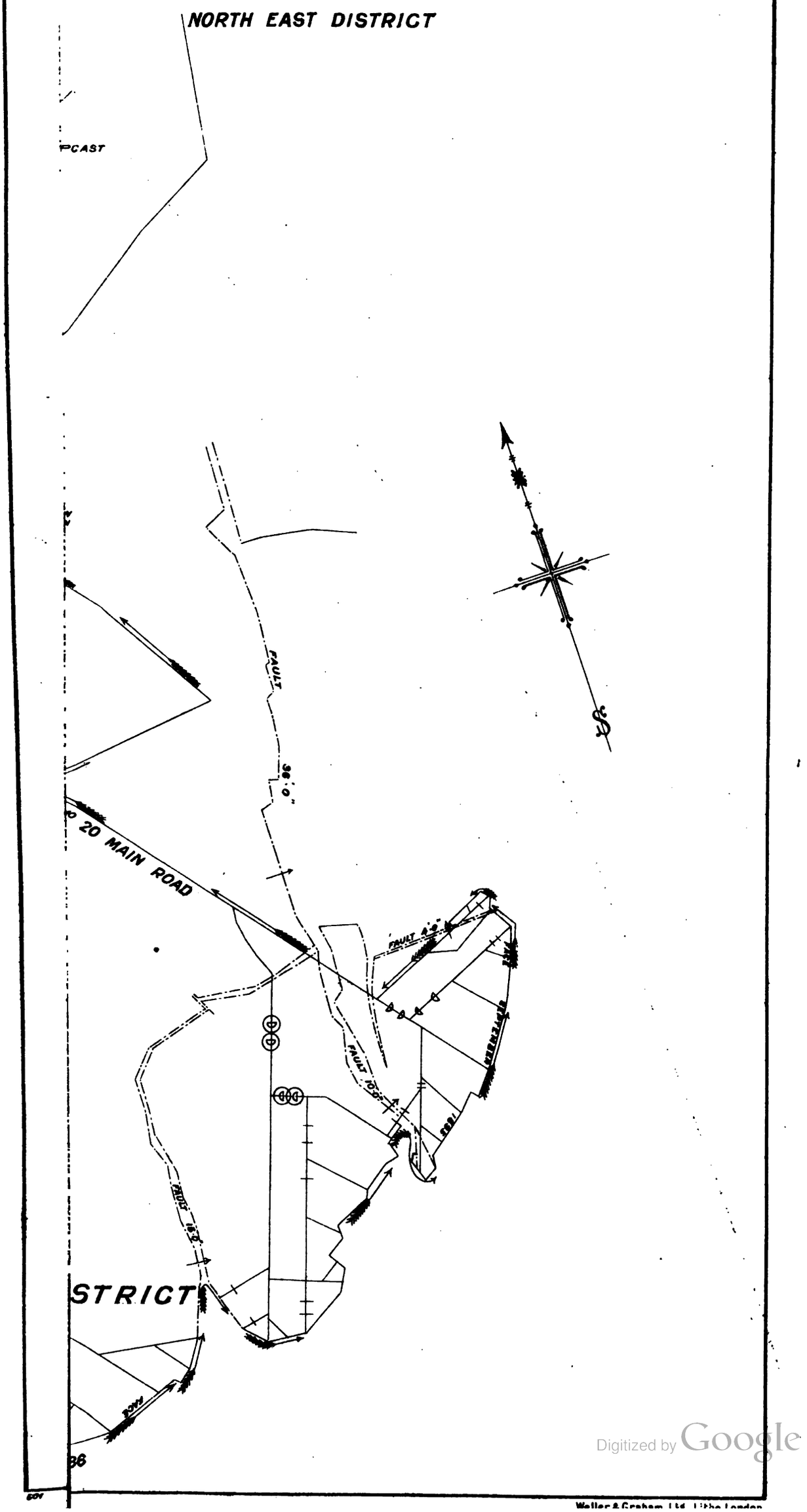
11909. (*Mr. Ratcliffe Ellis.*) What is the distance from the beginning to the end of the protected area ?—From the shaft to here it is 143 yards. Periodically it was whitewashed.

11910. Your view is even if there were not these roads the flame would have stopped before it got to the end of the protected area ?—Yes. The flame never reached there.

11911. (*Mr. Smillie.*) The flame was turned back ?—

* *See* Plates X and Xa. † C-7947. (1896).

Digitized by Google



Digitized by Google

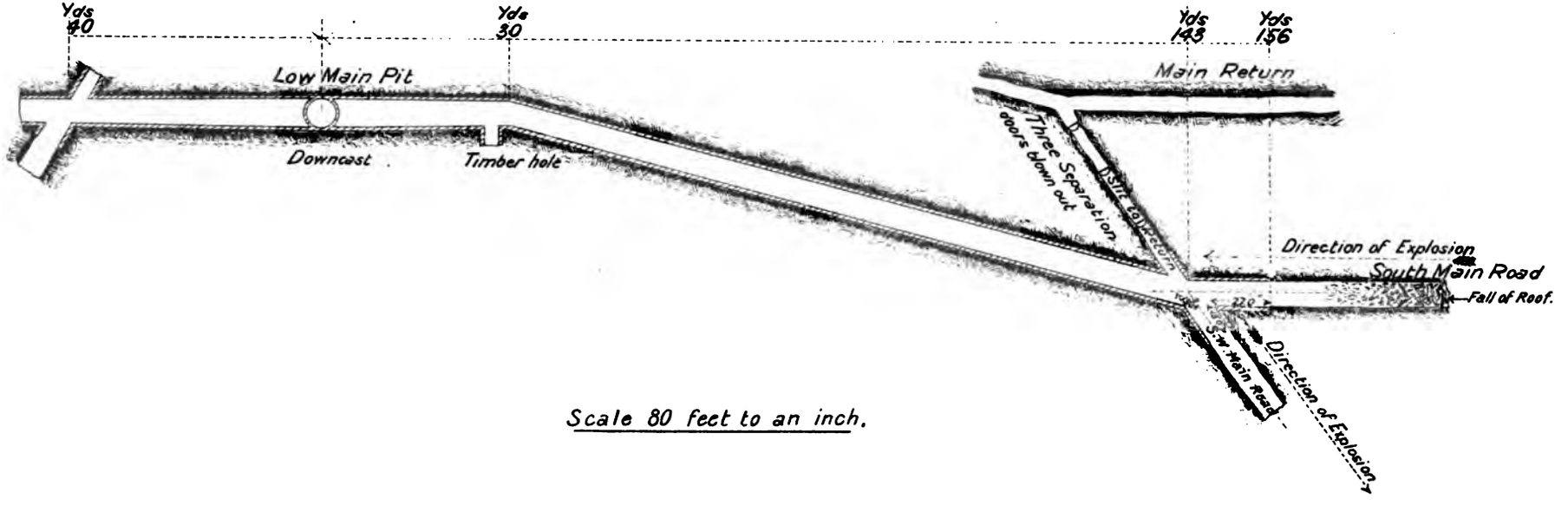
Waller & Graham Ltd. Litho London

Digitized by Google

BLACKWELL COLLIERY
EXPLOSION 11TH NOVEMBER 1895

PLAN ILLUSTRATING THE EFFECT OF DUST-LESS ARCHING

SEE EVIDENCE OF MR ISAAC HODGES 11902.-11944.



Scale 80 feet to an inch.

Digitized by Google

Digitized by Google

Yes, because there was no more dust or fuel to feed it.

11912. (*Mr. Ratcliffe Ellis.*) Supposing there had not been a chance of turning back what would have been the effect?—The force would have continued, but not the flame.

(*Mr. Smillie.*) There was no obstacle.

11913. (*Mr. Ratcliffe Ellis.*) 40 feet then is sufficient to let the flame go?—The flame went round that. It is exactly 40 feet, the measurement round that wall.

11914. (*Mr. Enoch Edwards.*) It would touch round *here* again?—It could not pass that section to *there* although the force was so great that it blew the separation doors all to pieces.

11915. (*Chairman.*) Where?—In the road to the return.

11916. Was that dusty as well?—Yes.

11917. That is naturally where it would go?—It smashed up those three doors, but as the dust was not inflammable it could not pass into the return.

11918. (*Mr. Cunynghame.*) What do you mean by force going through without the flame? There is nothing but an airwave. For instance, it comes to here (*indicating*). The explosion would not go on *here* and the products would not be formed, because there is no coal dust. What do you mean by the force going on? No air could be forced like air out of a soda-water bottle, because there is no expansion produced. You must mean an oscillating air-wave?—Yes. It smashed those doors into fragments.

11919. It did not *here*?—No, it just moved a few tubs. I should like to draw your attention to the remarks made by Mr. Stokes, H.M. Inspector of Mines for the Midland District at the time of the explosion. The Inquiry was conducted by Mr. Stokes and Mr. Chester Jones. I read in Mr. Stokes' evidence given before this Commission that the Blackwell Explosion proved that arching could not stop an explosion. I think this supposition is incorrect; it is true that the short length of arching failed to stop the explosion, but the large piece of archway did stop it. Shall I read the description in Mr. Stokes' Report?

11920. (*Chairman.*) He says: "It is difficult to explain the erratic course taken by the explosion as it approached the downcast shaft. The roadway from the shaft to the junction of the South and South-West haulage roads is arched with brickwork, for a few yards along each branch road. There is also a road leading into the return airway near the junction in which three doors are fixed. The floor of the roadway in the arching is damp, and the walls of the arching are occasionally whitewashed, so that little dust would be adhering to the brickwork. The explosion travelled from the shot towards the bottom of the downcast shaft, and directly it entered the arching it failed to continue in a direct line and across the shaft bottom or up the shaft, but turned round into the south-west roadway at an angle of 50 degrees, striking down and severely burning an official who was proceeding to his work at a distance of 264 yards from the entrance of the archway, and causing destruction of material and falls of roof for a distance of 1,100 yards from the junction of the main roads. The bottom of the downcast shaft was only 143 yards from the junction of the south and south-west main roads, but beyond the breaking of a glass lamp and the pushing forward of a few loaded tubs into the shaft bottom, no damage was done, and the men sitting in the lamp cabin 20 yards on the opposite side of the shaft bottom, and in a straight line, were uninjured."* That is what you told us?—Yes.

11921. *This* is a smaller road than *that*, and I imagine that the doors were pretty near, were they not?—No.

11922. There was a more cramped space where probably the air-wave would get rather more impetus than this. It would be more inclined to blow out in a broad road than in a narrow road?—Yes.

11923. The air wave did go *there* as well as *here*?—Yes.

11924. (*Mr. Cunynghame.*) And stirred up the coal and ignited again?—No.

11925. It ignited *that* side, but not *that*?—Yes, because that was going to the return, and the dust in the return proved to be uninflammable. It blew out the doors, but there was no ignition on the return side of the doors. I travelled along the return to find the men.

11926. Even if the force of the explosion went along *here* and knocked a man down, the great point is that it would not form gas and poison him. Ninety-two per cent. of the men die of poison. You get no poison here, and the consequence is those men, even though thrown back, would have had a large chance of recovery. Do you agree with that?—Yes.

11927. (*Mr. Ratcliffe Ellis.*) Supposing that there had been no road in *that* direction and no road *here*, and this had been a straight road, what would have happened?—The formation of a continuous explosion would cease at that point for want of fuel, but the airwave would continue until it spent itself.

11928. Does this give any indication of the length of the protected zones necessary to prevent the consequences of an explosion?—I say that 143 yards proved sufficient to protect that fiery wave from passing forward to *there*—the pit. It is on the strength of that, and only upon that evidence that I propose to spend many thousands of pounds in sectionising our mines, because I was so struck with that fact as an assistant manager in those days. I asked the general manager of the Blackwell Collieries to let me bring *this* Plan to show you.

(*Chairman.*) If, as Mr. Ellis says, the explosion had no means of travelling *here*, of getting anywhere but in front, it must have gone some distance beyond, but we do not know how far.

(*Mr. Cunynghame.*) Even then an explosion not accompanied with dust and not fiery.

(*Chairman.*) The fire must have gone beyond.

(*Mr. Wm. Abraham.*) There would be no flame beyond that point.

11929. (*Mr. Ratcliffe Ellis.*) Why do you say 143 yards?—It is 143 yards from *there*—the junction of the two main roads to the pit shaft.

11930. Why do you take *that* point (*indicating the pit*)?—That was the point at which the last effect of injury was apparent.

11931. You do not think that is affected by there being an outlet at each side?—No; whatever air pressure there was at that time would be equal in all directions *that* side, or *that* side, or *that* side. If *this* length of arch and *that* length of arch had been equal to that, it would have expended itself in all three ways.

11932. You think that 143 yards was sufficient under those circumstances?—Yes, so far as that was an experiment. The shot was 418 yards away. After it turned round it got new vigour and travelled 1,100 yards.

11933. (*Mr. Ratcliffe Ellis.*) On a dusty road?—Although it had been stopped in the main direction.

11934. (*Mr. Cunynghame.*) It got new vigour after passing how long a zone?—*This* tiny zone of 40 feet.

11935. According to you, 40 ft. is not enough?—No; 143 yards proved to be enough.

11936-7. (*Mr. Ratcliffe Ellis.*) You have nothing between 143 yards and 40 ft.?—No. I only know that 40 feet was not sufficient and 140 yards was sufficient. In my own case I am taking 150 yards.

11938. You are speaking from observation directly after the accident when you went down?—I was assistant manager in Mr. Maurice Deacon's time, and these were the diagrams I made at that time. I have obtained them on loan from the Colliery Company by the courtesy of Mr. J. T. Todd, the present general manager, for the purposes of this Commission.

11939. (*Dr. Haldane.*) It is certain the explosion did not travel to the shaft?—The Official Report corroborates all I know, and gives exactly what did happen at that point

11940. (*Chairman.*) You come to a totally different conclusion from Mr. Stokes. Mr. Stokes' conclusion is that the brickwork did not stop it, and your conclusion is that a certain amount did?—Yes.

11941. (*Dr. Haldane.*) It is quite certain the explosion did not reach the downcast shaft—I mean the flame did not?—The violence did, but not the flame.

11942. (*Chairman.*) Not very great violence?—No, the violence toned down very rapidly as soon as the actual ignition ceased.

* Mr. Stokes adds: "The only explanation that I can give for this curious phenomenon is that when the explosion arrived at the junction of the roadways it would have to face a double current of air, upwards of 27,000 cubic feet per minute, which was entering the mine under conditions produced by a large fan running at 3·20 inches of water-gauge. Rather than face this pressure of wind it turned round the arching with the divided current of air, and finding sufficient dust to supply the necessary fuel, it passed with the current into the South-West District, and continued its progress until exhausted."

Digitized by Google

Mr. I. Hodges

6 Feb. 1907.

11943. (*Dr. Haldane.*) What evidence was there that there was no flame in the downcast shaft?—There was no charring of the dust on the coal tubs. On *this* road there was evidence of charring in the direction of the blast. After you got into the porch there was some little dust, but not sufficient to carry the explosion.

11944. Were the cages wrecked?—Not touched. If I may just again read that portion from Mr. Stokes' Report I should like to, because I think it is very important. "The explosion travelled from the shot towards the bottom of the downcast shaft, and directly it entered the arching it failed to continue in a direct line and across the shaft bottom or up the shaft, but turned round into the south-west roadway at an angle of 50°, striking down and severely burning an official who was proceeding to his work at a distance of 264 yards from the entrance of the archway, and causing destruction of material and falls of roof for a distance of 1,100 yards from the junction of the main roads. The bottom of the downcast shaft was only 143 yards from the junction of the south and south-west main roads, but beyond the breaking of a glass lamp and the pushing forward of a few loaded tubs into the shaft bottom no damage was done, and the men sitting in the lamp cabin 20 yards on the opposite side of the shaft bottom, and in a straight line, were uninjured."

11945. (*Chairman.*) How much dust do you say there was. You say that there was a certain amount?—A small amount of dust. The archway was white-washed from time to time, and the dust that is carried down from the screens——

11946. How often would the archway be dusted?—It is difficult to say now. After a lapse of 11 years it is difficult to say. The general rule for the dusting of porches like that is every month.

11947. Is that sufficient to keep down the dust?—It depends upon the position of the screens at the surface to the pit top.

11948. You think that something should be done to prevent the screens being placed within a certain distance of the shaft?—Certainly in new collieries where it could be done.

11949. You talk about using an air pump to suck up the dust, but that you have found it inefficacious?—The progress was so slow that it took the machine and three men more than a day to thoroughly clean the length of this table.

11950. How do you prefer to do it? Do you do it by steam, jets or a hose?—I would clean an archway by the vacuum cleaner, but the experiments we made were on the naked rough sides of the roadway, a roadway lined with packs whose crevices were filled with dust.

11951. Would you always have an archway in your sectionising zones?—I prefer side walls and girders with a concrete roof. It is easier to build. These zones must be built at the time the pit is working, and you have not to trouble with centres.

11952. You must have a zone specially built for the purpose. You cannot make ordinary haulage roads with timbers, and so on, into a sectionised zone?—Quite impossible.

11953. No amount of cleaning would do that?—I do not think so. After the Blackwell explosion I observed large quantities of dust which appeared to have been sucked out of the old packs and crevices in the sides of the roadway by the vacuum caused by the explosion, but this dust was not observable there during the ordinary time of working.

11954. If you did not have a specially built zone to sectionise a mine you would not be sure of being able to properly dust it?—I do not think so.

11955. Then in Paragraph 9 you say that it is impossible to estimate the cost of watering and also the cost of keeping roadways open subjected to constant creep and lessening in sectional area. Then you make some observations with regard to the lessened conditions of efficiency and health, and you say that the workmen in seams up to 150 yards deep are considerably disadvantaged by the wet nature of the work, wet clothes, and that they lose in general health. Why do you say that? What evidence have you that they lose in general health?—The Whitwood Collieries have been existing for 60 years and a great number of our workmen who have been with us continuously for nearly half a century often come to us for extra allowances of coal, and also when they have finished work for assistance and for pensions, and I am thus able to see the older members as well as the younger ones. In the shallow seams they have to have special allowances of house coal to dry their clothes, and they are very subject to rheumatism.

11956. Have you any statistics to show that their health is worse than the others?—Only my daily observations and the fact that the older miners who have worked in wet seams and who come along for recommendations to Buxton, and other health resorts, for treatment for rheumatism, always allege that the wetness of the seams causes the rheumatism.

11957. You have no statistics to show what proportion are subject to rheumatism of those working in dry seams compared with those working in wet seams?—No.

11958. Then in paragraph 10 you approve of the addition of salt, and say that it cakes the dust, sets the floor hard and greatly improves the roadway. Have you tried it experimentally?—Yes. The water from the Haigh Moor Rock contains 7,000 grains per gallon of chlorides and sulphates, and I am taking that down to the deeper seams because it is much more efficacious in laying the dust. After the pits have been stopped for the week-end, on Monday morning you see the salt exuding like hoar-frost all over the dust.

11959. You know by your own experience that salted water is more efficacious?—Yes. This is not an artificial preparation, it is the salt water that is naturally made from the strata.

11960. You could have an artificial preparation?—Yes. I have had it analysed. I thought it might be beneficial for the rheumatism for the miners, but it did not prove to be suitable.

11961. You think that it would be prohibitive at the Whitwood Collieries to prevent shot-firing unless all the workmen were removed from the seam and from all seams communicating with the shaft at the same level, because 68,000 shots were fired, nearly all during the working shift. Why nearly all during the working shift?—Because the great bulk of our firing is done in the coal and can only be done at the time when the miners are at the coal face. Every shot fired on a main road is only fired after direct inspection by the manager and a written authority that he has seen it and agrees, and every condition imposed by the Explosives in Coal Mines Order is carried out. There are not four in the whole area per annum that are fired on main haulage roads.

11962. You say with shot-firing in the absence of the miner, that the danger would be seriously increased as the roof must remain unsupported for a considerable period, and that it would be very treacherous when the miner returned to work. Do you think that it would be absolutely detrimental to the safety of the mine that a rule should be passed that shot-firing should only take place between shifts?—I think so.

11963. (*Mr. Enoch Edwards.*) Suppose it is necessary to put timber?—We find the coal-cutting machine has very largely increased the number of shots. If a miner wants a shot in a large piece of coal when that shot is exploded there may be a prop blown out. Immediately it is reset, the shot-firer examines the roof, and the miner takes the necessary steps to keep up the roof. If the miners were away from the working faces when shots were fired the probability is the roof would be weighted, and it may have fallen in.

11964. Who is the shot-firer; is he a hewer?—No, a person whose wages do not depend upon the amount of mineral he gets; therefore a day-wage servant of the Company.

11965. (*Chairman.*) You do not have to ask the Manager for leave to fire a shot?—No; the deputy of the district gives the authority to fire, and the workmen prepare the shots.

11966. With regard to watering at the face, do you consider it necessary that the Rule should be observed that watering ought to take place within 20 yards of a shot?—No.

11967. You do not do it?—No, not at the working face.

11968. You do not attend to that Rule?—There is no rule that at the working face it should be watered within 20 yards.

11969. The Rule says, "If the place where a shot is to be fired is dry and dusty"—that may be the working face. You may have a dry and dusty working face?—At the working face the term "dry and dusty" does not convey the same meaning as "dry and dusty" would on a haulage road.

11970. You would say that there may be dry and dusty working faces?—I would say that it is not impossible,

Digitized by Google

11971. If the place where a shot is to be fired is dry and dusty, the conditions are observed, that is to say, unless there is watering, or in the case where watering would injure the roof or floor, unless the explosive employed in firing the shot is so used with water or other contrivance as to prevent it from inflaming gas or dust ?—Yes.

11972. Do you adopt the second of the alternatives ?—No.

11973. Neither ?—We adopt the permitted explosives in the whole of the mines, but the provision mentioned refers to a water cartridge.

11974. As far as your mine is concerned, Rule 12 (*h*) with regard to the working place is an absolutely dead letter ?—Entirely so.

11975. You do not think that there is any necessity for watering round shots under those circumstances ?—Not where we are firing this quantity of shots per annum. Since the commencement of the Explosives in Coal Mines Order we have never had an instance of injury from shot-firing.

11976. You agree that the cause of past explosions has been shot-firing in main intake haulage roads. Would you not say that in any haulage road they should only be allowed by written permission of the Manager for each shot. Do you not think that should apply to any haulage road ?—Yes.

11977. You say here that only in main intake haulage roads they should be allowed. Would you not apply that to the whole of the haulage roads ?—Yes, to the mechanical haulage roads ; in the horse haulage roads from the face to the main haulage roads I do not consider it necessary.

11978. Where you have shot-firing in the haulage roads, and where it was necessary that the Manager should give the order, I suppose you would have the watering ?—Certainly.

11979. In fact you are obliged to ?—Yes, and we should only fire when men are absent from the mine.

11980. Then you say such shots might be restricted to a period when the regular workmen were absent from the mine ?—Yes.

11981. (*Mr. Cunynghame.*) The plan which you have shown us showed that the explosion stopped short of the working places ?—Yes.

11982. Were there any men in the working places uninjured in the explosion ? I should like to hear about the men who died.—In the south district, where the shot was fired, the head deputy happened to be in the face, and I was greatly of opinion that I could save him alive. I travelled that distance to find him lying dead over the remains of a door, but quite uninjured. He had been asphyxiated. He had been in the working face, and in coming out he tripped over the door-bands and had been unable to recover.

11983. He was poisoned by carbon-dioxide ?—Yes ; there was great evidence of the force of the explosion at that point. The doors were shattered, but he was untouched.

11984. He had been further in up at the face, and heard the explosion, and he had tried to escape ?—I found his marks at the face. He had put his deputy's marks on each stall. He had heard the noise of the explosion and come out into the afterdamp.

11985. If he had remained where he was he would, in all probability, have been reached by some rescue party ? —I am certain that he would, and I should have been there six hours afterwards.

11986. Was there evidence that after the explosion had taken place the poisonous gas formed by it had been conveyed by the intake current to the working places ?—Not for any great distance.

11987. One would have thought that the carbon-dioxide forming along the roadways in the intake would be carried right up to the working places, and would have gone past the men and poisoned them. What do you think about that ?—I have been unable to form any clear conception. I travelled 900 yards beyond the air current. If there had been any great proportion of carbon-monoxide I could not have lived. The chances were against our living ; but we had no effects from it. We suffered from carbon-dioxide.

11988. Is that not because the fans were working ?—The separation doors had gone.

11989. The fans were working ?—Yes.

11990. You went with your back to the air along the direction of the intake current ?—The intake roadway was impassable. The roads were down so badly. I travelled the return in the face of the return current. I will show you on the plan.

11991. Never mind about the detail. It is the fact I want. You were travelling against the current ?—Yes.

11992. Therefore, you might have expected to be meeting the stream of carbon-monoxide coming out from the old explosion ?—Yes.

11993. There was considerable risk of being poisoned ?—Yes.

11994. Was there anybody overcome in the rescue party ?—We lost all our lamps but one.

11995. They went out ?—Yes ; we were very much exhausted, and we had to collect together. I sent on two and stayed with the three others—there were six of us—and we were eventually rescued, feeling considerably the effect of it, but none of us lost our lives.

11996. There is a danger of the gas and the carbon-monoxide which is formed being carried to the working places by the intake ?—Yes.

11997. In spite of that it is safer to remain in the working faces and not go into the roadways ?—Much safer. As a proof of that there were three men working on the return side of where the explosion occurred. Although the products of the explosion were carried round, they were probably so much diluted that it did not affect the men, and they were recovered all right, because they were found at the working face.

11998. I suppose in these explosions the great danger to the men is not nearly so much that of the air shot, as the danger of poisoning ?—The percentage of deaths by poisoning is very much higher.

11999. A strongish explosion might go right over a man ?—Unless he was standing.

12000. But he would be afterwards killed by the poison ?—Quite.

12001. An explosion might go right over a man, spare him, and he would be poisoned afterwards by the carbon-monoxide ?—Yes. One of the rescue party after being out of the mine four hours fell down insensible and was with difficulty recovered, although we had not suffered so severely in the pit.

12002. It comes rather to this, that all these protected zones, even if the explosion went past them, ought to be found to become havens of refuge, because the poisonous gas would not be there ?—They would be too near the point at which the explosion ceased. They would be no use as havens of refuge.

12003. Still, the explosion goes pretty near to the working places and those remain, to a certain extent, as havens of refuge ?—In the working places you have the fact that there is a large area of goaf which is filled with stagnant air, and to some extent with gas. There is a very large area back in the goaf to dilute the products of the explosion. If you had a sectionising zone, the whole course of that archway would be swept by the products.

12004. Do you think that the miners are sufficiently aware, as a rule, of the greater safety in a case of a thing of this kind, I mean by remaining at the working face ?—I have from time to time given lectures to our miners on the advisability of remaining at the face, because I know that so many lives could be saved, but it requires a great deal of courage to remain in the working face when the miner thinks he may rush to the pit bottom and get out. I have no hope that anything I have said will do any good.

12005. Courage, after all, consists in taking the safest course. Once you hammer it in that it is the safest it may do some good ?—We are now asking that the miners four times per year shall travel the returns and to the outlet shafts in every seam. I have some difficulty with them. Even the half-an-hour extra, which is required four times per annum, is rather more than they will put in. They say it is time expended for a thing which may not happen.

12006. I do not suppose a circular from the Home Office would do any good to impress the men with the necessity of remaining where they are ?—I think it will come with the increased knowledge of the deputies. The deputies and the mines officials will know it, and they may be trusted at the time of an explosion.

12007. Supposing you had a system of telephones in a mine, do you think it possible that it would remain sufficiently unbroken to be within the reach of the men to let you know where they were ?—I think it is possible, and

Digitized by Google

Mr. I. Hodges 6 Feb. 1907.

we are now putting telephones over the whole of the main roads, so that we can speak from the far workings to the shaft.

12008. Have you ever had experience, as far as you know, or have heard of cases where the telephone wires have remained untouched after an explosion? Do you think that they would be broken?—It would depend entirely upon the district. If the district was traversed by the force of the explosion, I am sure no telephone wires could stay. This roadway, 900 yards long, would vary in height from 2 ft. to 20 ft.—often in the length of this table—and very often the roadway was over the bars that supported the former roof.

12009. If the wires were close down on the roadway they would be covered and would not get broken?—In that case I would lay them in the compressed air pipes. They then might stand that amount of hard usage.

12010. You are rather in favour of telephonic communication in larger mines?—I am putting it in for other reasons. It is advantageous in haulage, and in the case of an accident it is useful to get the officials to the place. I think it is advantageous in every way.

12011. As you have been putting it in have you any rough figures of the cost which you could give us, approximately, what it would cost per yard?—The cost is very small, because the signal wires for the haulage are the wires for the telephone. It only requires the speaking apparatus at each end.

12012. They would be very likely to be broken. They are in a very awkward position. It would be better to have a telephone more protected than that?—For the purpose of use in an explosion?

12013. Yes?—Yes: the wires would be quite unusable.

12014. Would it be expensive to have telephonic communication safer from being intercepted by falls of roof or by accidents?—It is very difficult to realise what measures would have to be taken to protect the wires in the case of an explosion. If you had compressed air mains I should think that it would be a fairly easy matter, because you would lay them in the compressed air pipes, and you would have your security already made; but if you had to lay the pipes for that purpose it would be a very serious cost.

12015. (*Sir Lindsay Wood.*) Referring to the question of telephones, it would be difficult to get at the station where the telephone instrument was set?—It might be very difficult indeed. The telephone installation usually ends at the point where the haulage ends.

12016. You could not have it much further in, because the face is always progressing?—You would have it at the last point where the roads diverge—the last haulage station.

12017. That would be a dangerous place for the men to come up to?—I should think so. It would be about the point at which an explosion would be likely to end.

12018. Is not that one reason why it is generally safer to remain in the face than to come out after an explosion due to the stoppings being blown out, and between the shaft and the face and allows the foul air to escape?—Certainly. The air currents short-circuit, and you may live for a long time on the air impounded in the working faces and goaf.

12019. Shots fired in the main roads are the chief sources of danger from shot-firing?—Distinctly.

12020. Do you suggest anything which might make shot-firing in the roads more safe?—The complete cleansing of the dust from the vicinity of the shot; but the difficulty is shown in this Blackwell explosion. The dust that caused the explosion was solid dust in the crevices of an old crack, which could not be observed.

12021. You think that you could not water sufficiently well round a shot to prevent an explosion?—I am sure you could not have prevented that unless you had water at a great pressure, which would have found out that crack; and I think there was so much dust in the crack that water could not have entered. A shot-hole may come in contact with a slip or a weight break, in which grinding has been continuing for 10 or 12 years. That in itself makes a fine dust and forms a dangerous position.

12022. Then you would have to get dust out of a crack mixed with the air before there would be any danger?—Probably.

12023. (*Dr. Haldane.*) The shot would blow the dust out?—It would. I am not clear what the actual effect would be. The dust might lie so compactly that the shot would not explode it. If there was any residuum from a shot, which had caused the dust to be in a violent state of motion it might still retain sufficient heat to ignite it.

12024. (*Sir Lindsay Wood.*) The crack would have to be a larger one to get the dust into motion?—I do not think it would have to be larger than cracks are usually on roads a considerable distance from the face.

12025. You think that watering would not be effective in all cases at all events?—I am sure so.

12026. With regard to putting in watered zones, where would you put them—further back in the face?—I have prepared a plan showing the zones we are now building with the view to minimising the chance of any such disaster as at Courrières. In each case they are built between the working face and the pit bottom. That face is two miles from this pit bottom. The dust-free zone at the pit bottom would preserve the shaft, and the dust-free zone near the face would preserve the haulage road and separate the haulage road from the working faces. That zone would protect it from the upcast shaft.

12027. That is between the working face and the main haulage roads?—Yes, the idea is to sectionise the working faces from the haulage roads, and if that should fail to be an efficient barrier, to stop the explosion from crossing the shaft and getting to the other districts.

12028. Supposing the explosion took place on the main roads?—In that case you would have a barrier at the shaft and a barrier at the end of the haulage before reaching the district. Supposing that main road was one of the danger points, if an explosion occurred there the explosion would be cut off at *that* point and at *that* point.

12029. And not spread into the face?—And not spread into the face. It is difficult to say what number of these would be required. The cost would be a large one.

12029A. (*Chairman.*) You would have them at 150 yards?—At the main winding shaft I am taking them 300 yards in either direction, and for that one shaft alone it means about ¾ mile of arching, because there are full and empty roads from north, south and west.

12030. If you keep them wet they need not be so long?—I formed the impression that it is better to have one sectionising zone which you could absolutely depend upon than to have it a little too short and pass the explosion.

12031. You do not suggest that a dry zone would stop an explosion to the same extent as a wet zone?—I think so. If the dust was not there it is immaterial as to the moisture.

(*Sir Lindsay Wood.*) It is generally supposed 100 yards would be quite sufficient in a wet zone.

12032. (*Mr. Wm. Abraham.*) In your opinion, to keep the roads quite clear of dust, properly kept zones in various places will absolutely prevent explosions extending from one place to another?—From one district to another—that is my opinion.

12033. You think that would be more effective than watering?—I think watering is impossible, and undoes what it is intended to do. First of all it provides its own dust by causing the roads to work and creep, and it keeps you continually working at the roads. I have given you an instance where we have had to "rip" 20 ft. to hide the effects of water.

12034. Would that keep you continually repairing your roads, or would it not finish when a certain depth is cut into the road?—It would depend entirely upon the strata. If you had a strong strata somewhere above you that you could keep cutting until you reached it, I agree that there would be a day on which you would stop. If you have no kind of strong strata between one coal seam and another there would be no stop. It is easy to demonstrate that in the seams. Haigh Moor is a coal seam with 26 yards of rock roof and a very soft floor, but water put upon the floor causes it to heave very much indeed, and they are always denting that; in course of time it would cease, but it would be many years. In the Silkstone, the deeper seam, I know of no strong ground we could get to. Every road in the dry takes 10 years to complete. We are at it continually for 10 years without any water at all.

12035. (*Mr. Ratcliffe Ellis.*) Have you found, from your experience, that there is a difference in the character of the dust from the different seams of coal?—Yes, it depends whether the seams have much dirt in them.

12036. Is that general? Do you find a particular seam which is comparatively free from dust and another seam in which there is a great deal of dust?—Yes.

12037. You could say that applies wherever that seam

Digitized by Google

happens to be, not merely in the same locality, but it is incident of the seam ?—I would in some cases; in others, I would not. In hard coal I should say that might be fairly generalised, that the conditions would apply over a district.

12038. Do you find any difference in the explosive, or non-explosive character of the dust attaching to particular seams ?—That is difficult to answer. At Blackwell we had tried with those dusts to make them explode. We were unable to make it explode, and yet we had an explosion.

12039. Can there be in your view a purely coal dust explosion without any gas at all ?—Yes, that is proved by the screens and by the storage hoppers for washers.

12040. You think that is so—that there can be a purely coal dust explosion ?—I am convinced in the Blackwell case it was. There were 16,000 ft. of air passing and there was no gas at all.

12041. Do you consider that the dust which goes down the shaft from the screens is a considerable quantity ?—I do.

12042. Sufficient to require precaution to be taken to prevent it ?—I think, except the main haulage roads, it is the most important of all.

12043. The quantity that goes down ?—Yes.

12044. Have you seen any arrangement for collecting this dust ?—No, but I have read of them. Where you have wood conductors and buntons you collect a large quantity, and you must clean every month, and then the buntons are covered to the angle of repose, so that no more can get on.

12045. To remove the screens would be a serious matter ?—It would be almost impossible for many people.

12046. Have you any suggestions to prevent this dust going down except by removing the screens ?—The best thing is to enclose the tipplers and the jigging screens and exhaust the dust by a fan.

12047. Has it occurred to you that that might be prevented by enclosing the top of the shaft, covering the top but raising the sides of it up ?—No, but I can see that it might be a benefit, although none of us like to wind out of a shaft covered so well as winding with a shaft open.

12048. You think expedients might be adopted to prevent a considerable quantity going down the screens ?—I think some expedients will have to be found. I think that the removal of the screen will be too great a penalty.

12049. How long is it since you have adopted the new kind of tub ?—About four years.

12050. Have you noticed whether the quantity of dust was decreased during that period ?—Yes, very considerably.

12051. And you attribute it to that cause ?—I do; to the fact that our ill-constructed tubs lost so much coal. The more coal that is spilled, the more the horses and men walk on it and it grinds up.

12052. You pay for what is in the tub when it gets to the top whether the tubs are small or large ?—Yes.

12053. Now with regard to the protected zones, could there be any General Rule suggested where these protected zones should be ?—I think that the whole subject is one for experiment, and particularly one for experiment with inflammable dusts to define the protective measures that should be taken. I must confess that my Company has undertaken this at considerable expense, because it feels that something should be done, and up to the present we believe that we are in the right way in sectionising district from district. Whether anything more than that will be required I am not able to say.

12054. What you are doing might be described in that way; you are sectionising district from district ?—I am not attempting at present anything more than that.

12055. What you are doing is, you are getting your protected zones by clearing them from dust and not by watering ?—That is so.

12056. In the particular area that you protect, the road has to be specially constructed ?—Yes.

12057. So that you would have some girders at the top and as practically as smooth a surface as you could get ?—I should attempt to make it so.

12058. In order to be entirely clean from the effects of dust ?—Yes.

12059. You said that the vacuum cleaner had not been applied to that specially constructed road ?—No.

12060. It is not necessary, perhaps ?—No, it has not been necessary. We can sweep it off. The vacuum cleaner I have is not our property; it was built for the purpose of experiment, but we do not own it. I suggest that we should keep a vacuum cleaner to clean the sectionising zones, and I suggest that as the best means of doing it.

12061. Do you know any mine in which there would be any serious difficulty in providing these zones ?—I do. I believe in the very deepest mines brickwork is almost impossible. I am speaking of mines 700 yards deep.

12062. Have you any suggestions to make as to how protected zones should be provided in those seams ?—I have not. I know that attempts have been made with great strengths of concrete and brickwork and oak, and they have all failed. I am compelled to admit that a mine in that case should have an exemption.

12063. A very deep mine would be likely to be dry and dusty ?—Yes, quite so, and more so than shallow ones.

12064. Watering might do very serious harm ?—Yes, it is likely to be more serious there than elsewhere.

12065. And the possibility of constructing anything that would stand, in the way of masonry, is very difficult ?—It is much more difficult than the problem which frees me.

12066. In the case of the deeper mines which are dry and dusty you can offer no suggestion ?—The very deep ones ?

12067. Yes ?—I have no suggestion at present to offer.

12068. (*Mr. Wm. Abraham.*) They must be closed then ?—I was down a mine in Belgium 1,200 yards deep, where it seemed to me quite impossible to provide adequately against the danger of dust.

(*Mr. Wm. Abraham.*) If watering cannot be carried out they must be closed. If the difficulties are such that the zones cannot be built, then you have either to close the pits or work with the danger which you know.

12069. (*Mr. Ratcliffe Ellis.*) The coal which has to be won in the future you have to go a long way for ?—Yes.

12070. It is all in these deep mines ?—Yes.

12071. The upper seams are gradually getting exhausted ?—Very rapidly so.

12072. You have this difficulty, that the coal which has to be won exists in these conditions which make watering next to impossible, and equally make it very difficult to construct any masonry which would stand the pressure ?—That is so.

12073. That is a matter which you think wants consideration ?—Decidedly.

12074. With regard to shot-firing in the main haulage roads, I understand that it is your practice to have them brought before the manager ?—Yes.

12075. He would inspect the place ?—The actual spot.

12076. He would see what had to be done with the shot—what it had to do ?—Yes.

12077. I suppose he would sanction that there should be only that amount of explosive put in which was necessary in his judgment to do the work ?—He would give a written instruction giving every detail that must be carried out.

12078. He would give a written instruction describing every detail ?—Yes.

12079. That would be when the men were not in the mine, between the shifts ?—Yes.

12080. You are familiar with the provisions as to shot-firing in the Coal Mines Regulation Act and in the Explosives Order. Have you anything in addition to suggest that should have general application ?—No. I think the conditions are sufficient except that we have gone further than that and said that shots in the main haulage roads should have the special authority of the manager.

12081. That is in addition to the present Rules ?—Yes.

12082. You think that it would be desirable to make that compulsory ?—I think it is desirable.

12083. Do you think as a regulation that it would be likely to be unduly harrassing to anybody ?—I would not like to say. I could not answer for the whole county sufficiently, but in my case it is not unduly harrassing.

12084. Now, about the zones and where they can be constructed. In the case of Blackwell which you mentioned, you think that it is quite clear the 143 yards was sufficient to prevent the flame from doing any mischief, and also preventing any serious mischief from the blast ?—That was so.

Digitized by Google

Mr. I. Hodges

6 Feb. 1907.

12085. What about the afterdamp?—It did not cross the shaft. There were people sitting on the other side uninjured either by the force of the explosion or by poisoning.

12086. Do you think that the protective zone protected them from that also?—Yes. Had there been no protective zone the explosion as well as the afterdamp would have reached them. It could only protect them to that extent that it stopped the explosion.

12087. (*Mr. Enoch Edwards.*) In giving this sketch of Blackwell, these zones, I understood you to say that you had made experiments with the dust there and could not get an explosion?—These zones I am discussing are at the Whitwood Collieries, of which I am now manager. The dust experiments were at the Blackwell Collieries, of which I was assistant manager in those days.

12088. It is the Blackwell Colliery I want. I understood that you had made experiments with the dust and that you could not get an explosion out of it. That I took as your answer?—I read you an extract from the official Report: "Mr. Maurice Deacon laid stress on the fact that the dust from this mine had been tested by the Chesterfield Institute of Mining Engineers, and that they had been unable to produce an explosion."

12089. The brickwork you refer to there, or what is termed "zones" now, was not constructed because of the fear of a dust explosion. You never constructed it?—We had no fear of an explosion. This was in 1895.

12090. Now this question has come to the front, you bring us this to show us what happened at this particular colliery where the flame did not traverse the length of this archway?—Yes.

12091. You are asking the Commission to assume from that that if a similar construction were put down it is likely the flame would not traverse it?—I am telling you what I base my own opinion upon.

12092. I am not sure whether we clearly understood about firing shots at the face. There was a question or two put to you about shots fired at the face, as to what was your method of procedure. They are fired in very large quantities?

(*Mr. Ratcliffe Ellis.*) I asked about the main haulage roads.

12093. (*Mr. Enoch Edwards.*) I do not mean now. I refer to an observation some time ago. You called his attention to the General Rule with regard to watering at the face, and I am not sure whether we clearly understood his answer to that. Would it be fair to assume gas has not been found at this face?—No shot would be fired if gas was found, not even four inspections afterwards.

12094. Not having found gas at the working place do you consider if a permitted explosive is used you can go on blasting?—Without watering?

12095. That, I took it, was your answer?—That is my answer.

12096. Your answer was, "We did it, but there is no gas ever found in those working faces; if it were we should not blast."—I do not take it gas has never been found, but there has not been for the four previous inspections.

12097. You are still within the law, you understand?—Certainly.

12098. You quite see that the question we are rather dealing with now is to prevent wholesale destruction of human life after an explosion in other parts of the pits, such as the Courrières mine?—That is so.

12099. Is it possible to reduce still further the possibility of explosions at all in coal mines?—I think that the fatalities from explosions have been very considerably reduced within the last 30 years, from 1·4 per 1000 persons employed underground to about 0·1, and the only method of entirely preventing them—and I do not even know that that would—would be entire watering of everything in the pit. My contention is that the remedy is worse than the evil. I say that you could not water all these roads because of the nuisance and inconvenience both to the workmen and the employers, which would be a very serious one.

12100. They arise mostly through either naked lights or blasting?—Yes.

12101. Or defective lamps?—Yes.

12102. Naked lights and blasting will claim, I think, the majority of the explosions in mines?—Yes. Of course there is always the chance of a blow from a pick.

12103. I mean by the experience up to now?—I think so.

12104. Is it not possible to reduce the risk in blasting by more carefully assuring yourself that a shot is going to do its work? Explosions do not happen from an ordinary shot which does its work, but it is an ill-constructed or badly-fixed shot that blows out?—It is most frequently caused by circumstances arising from a shot which cannot, or has not, be foreseen. It may be over-charged, or it may have more work to do than it is expected to do, and you get an excess of heat generated.

12105. Is it within your knowledge that there is more indiscriminate blasting now than 10 years ago?—No. There is more blasting, but not indiscriminate blasting.

12106. Not in Yorkshire, perhaps?—No. There is more blasting occasioned by the introduction of coal cutters.

12107. There is not the old-fashioned cutting by workmen there used to be?—No.

12108. You blast it off now; you do not cut it?—No. The miner of to-day does not work so arduously as he did. He will not do that class of work. The only people who cut now-a-days are the old men, I think. The old men do the hard work if there is any to do. The young men will not hole. We have had to introduce machinery to do the cutting for them.

12109. Ordinary cutting has given way to blasting it out?—If the management allow him.

12110. You think that we could not foresee all the possible dangers of blown-out shots?—I do not think you could entirely prevent them, ever.

12111. (*Dr. Haldane.*) I should like to cross-examine you a little about this stoppage of the explosion, as it is so important. Are you quite clear that the dampness of the roadway here, the arched part of the roadway within the shaft pillar, did not stop the explosion?—No, because it was not ever damp on the sides and roof. The only damping was the damping in filling underground water-tubs to run behind the trains to lay the dust on the roads.

12112. Do you remember whether it was damp all along from the shaft to the end of the arching?—No, it was not.

12113. It was only at one place?—Intermittently.

12114. The floor was not naturally wet at any place?—No.

12115. There was some wet from the damping of tubs?—From the filling of tubs. They are filled to run behind the trains, and naturally they overflow, and the water keeps the floor damp, but not over any great area.

12116. The filling of tubs to put in behind the train?—This was a main and tail-rope haulage. Therefore they ran the tubs in trains, and usually put in water tubs at the end of the trains, tubs with perforated holes.

12117. That would naturally wet the road close up to the shaft, the filling place?—That is so.

12118. Was it not wet between that point and the in-bye end of the arching?—It was not wet.

12119. You are pretty well convinced that the dampness of the floor had not anything much to do with the stopping of the explosion?—It had a little, but it was no sufficient factor to alter my opinion that it was the dust-free length of brickwork that prevented the explosion killing the men beyond the shaft and passing forward to the other districts.

12120. Have you examined the evidence as to other explosions in order to see whether it has ever occurred that an explosion has traversed what is presumably a dust-free part?—No. I think those observations would have to be conducted on the spot. It is difficult to get accurate information from Plans alone. That porch is now in the same position that it was, and the Commission could investigate on the spot: They could see this length there.

12121. *This* was the man you referred to whose body was found *here* on the Plan—I mean the man who was found over the door?—No, it is that one (*indicating*). He was on *this* side, and the explosion had missed him, because it short-circuited in *this* direction. He was *there*, and his name was marked there. He came down *that* cross-gate and tripped over *that* doorband and died from the afterdamp. I found him with his walking-stick, his yard-stick and lamp, and piece of chalk, quite unsinged and untouched, lying dead.

12122. How did this man meet his death?—He was coming *this* way, and turned round and failed by about 6 ft. to reach the fresh air. (*The Witness indicated on the Plan.*) *That* is the intake: *that* is the return: the air

Digitized by Google

Mr. I. Hodges
6 Feb. 1907.

was leaking through *that*. Had his head reached there he would have lived, and he just failed by about 6 ft.

12123. How was it that the air was travelling along that main return after the explosion? Was this overcast not blown out?—No.

12124. The upcast shaft was still drawing air along that?—Yes, both winding shafts were absolutely intact: they were not touched. The air coming down there leaked through those doors, and had he got to the corner he would have lived.

12125. You are quite clear that the effect of watering at Whitwood Colliery would be serious?—Absolutely. I am speaking of the deeper seams. We have seams in which it could be done without a great deal of difficulty, but those seams chance to be the seams in which there is least necessity. They have a rock roof, which bleeds water and keeps the roads fairly damp. The seams where it is required are those in which we cannot do it. The deeper the seams the more trouble the water brings to us.

12126. You think that is on account of the pressure, and not on account of the nature of the strata underneath the coal?—I think both. I think that the strata there is more tender: and it is not only more tender, but it has a greater weight to sustain.

12127. You were speaking generally just now as if it would be very difficult to water very deep mines?—I say so.

12128. Are you not drawing that conclusion from your own experience in this particular seam?—And also experience in other seams. My deepest seam is 500 yards. When you go to very deep seams like Denaby and Cadeby at 700 yards their difficulties are greater. I can build arching and am building arching, and I bring this plan to show the immense amount of arching built, but when it gets to the deeper mines I am told by the Managers that they cannot keep brickwork in. Possibly you may have Mr. Chambers to give you that evidence.

12129. (*Mr. Smillie.*) Was this shot fired in the side of the main road?—Yes.

12130. Was it a brushing shot?—A shot in the side. There was a tail rope which was rubbing the side: the Manager had seen it during the week and said "It wants a bit off." When the Contractor tried to get it off he found it hard, and unknown to the Manager put a shot in.

12131. It was put in the solid?—Yes. I have made a drawing of the shot itself. *That* is a cross-section of the road. *There* is the rope running against the side, and when he put this shot in it found that weight break, and it immediately popped out and exploded.

12132. (*Chairman.*) Is there anything more you wish to say?—I think not.

12133–6. (*Dr. Haldane.*) Perhaps you will be able to mark for us the exact boundaries of the brick arching on the plan published with the Official Report?—I will, with pleasure.*

NINETEENTH DAY.

Thursday, 7th February, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

H. H. S. CUNYNGHAME, Esq., C.B.
WM. ABRAHAM, Esq., M.P. (Rhondda).
F. L. DAVIS, Esq.
ENOCH EDWARDS, Esq., M.P.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. TALIESIN EDWARD RICHARDS, called and examined.

Mr. T. E. Richards.
Feb. 1907.

STATEMENT OF WITNESS:

CLASSIFICATION OF DUSTY AND NON-DUSTY MINES.

12136A. (1) Dealing with the points specially under consideration, the Witness is of the opinion that the classification of mines as to dust will be attended with difficulty, as each seam in a colliery varies considerably in character; a few may be moist naturally; some may be partly so, while others are extremely dry. Their position in the pit section is somewhat of an indication as to this. Another variation may be noticed in both upcast and downcast pits—the downcast main roads being the most dusty as a rule.

QUALIFICATION OF DUST AND CAUSES OF EXPLOSION.

(2) It is extremely difficult to indicate which class is explosive, and which is not, without a chemical analysis.

The Witness agrees that the finest impalpable dust of pure carbonaceous matter must be that most ready to ignite, but the quantity necessary to ignite must be very large. Experiments have been tried at these collieries, with all kinds of dust—screens and roads—and placed in contact with large flames from "comets," but in no case has ignition been caused.

The Witness is possessed of information of an ignition of dust occurring underneath the screens in the small coal hopper, at a colliery in the North of England, but he has yet to learn that without some special detonation it is possible to produce such an atmosphere in a mine gallery.

The Witness believes that it is not possible to ignite coal dust by a naked light in a mine; the conditions of a dust-laden atmosphere, such as is found in or near a small coal hopper under a coal screen does not occur underground. A detonation accompanied by flame, either of an explosion of gas, or a blown-out shot, when accompanied by an atmosphere heavily charged with dust, are the component parts which he believes will cause an explosion.

(3) As to the locality where the most explosive dust may be found and in greatest quantity, the Witness has no hesitation in saying that in his opinion it will be found along the main haulage roads, where the velocity of the ventilating current is greatest, and from that point inbye, especially so towards the inner half, and is composed of the lightest particles which have been carried furthest by the air. This fine dust deposits itself on the upper sides of horizontal timbers and ledges of strata running along the sides of the roads. In and along the working faces, fine dust is not found; the particles of coal are coarser and mingled with debris, both of shale and carbonaceous shale. As the distance increases from the coal face, the dust on the horse roads

* *See* Plate X.

Digitized by Google

Mr. T. E. Richards.

7 Feb. 1907.

becomes finer, and when nearing the double parting or siding, the quality of the dust becomes impalpable, especially that lying on the upper timbers as aforesaid.

SOURCES OF EXPLOSIVE DUST.

(4) The Witness believes this to be threefold :

(*a*) Escaping of small coal and dust through the crevices and the ends of the trams, and, in the case of collieries where there are no revolving tipplers, of a certain residuum of small coal left in the tram after tippling.

(*b*) Dust and small particles of coal blown off the trams in passing outbye against the ventilating current, both on the engine planes and in the shaft.

(*c*) A small amount is obtained from surface screening. The small coal and dust from the above sources fall into the roadway, and are trampled by horses and men into fine dust, and it is whirled about by the eddies of air formed as the setts pass outbye. The exception is in the shaft, which being generally damp, prevents much of the dust passing.

The Witness does not believe that the removal of the screens away from the pit top (which has been the case lately at the downcast pit of Mardy Collieries, and which is now in a separate encased building) has made much difference in the purity of the air passing down the shaft.

The dust on main haulage roads from a dry thin seam may not always be explosive, for where the seam yields an amount of carbonaceous shaly matter, the goaf space is not sufficient to stow all the debris in, and therefore, a part of rippings will have to be hauled to bank, the dust from which, added to the debris sent out from the night repairers, will result in rendering the coal dust innocuous.

PREVENTION OF ACCUMULATION OF DUST.

(5) The Witness believes this can be brought about by making the trams as dust-tight as is practicable. Some years ago the trams in South Wales had generally iron bands 4 to 5 in. wide along the sides and back ; these are being gradually replaced by trams made of steel sheets, both sides and end, the single cross-bar being replaced by two bars, and lately by doors.

The trams in use in South Wales are large, and carry from 30 cwts. to 2 tons 10 cwts., the top of the tram being packed up to 12 to 18 in. above the sides and ends.

The idea of covering the tubs appears impracticable to the witness, and will entail considerable difficulties, both in the loading and unloading. So also is the suggestion of the vacuum collection of dust. The witness understands that experiments have been made in this direction, and have been proved to be a failure.

Spraying the full trams on their travel outbye is now practised at many collieries with good effect, the result being that the watered dust is not blown off by the ventilating current.

The periodical cleansing of dust and debris from the main and other roads is of considerable benefit in the prevention of any accumulation of dust.

WATERING DUST.

(6) A system of universal watering would be decidedly objectionable, and would most certainly tend to an increase in accidents from falls of roof and sides.

In cases of a universal system being ordained by law, the witness is of the opinion that the manager of the colliery would be compelled to water whether it would be safe for him to do so or not.

In the years 1904 and 1905, the deaths from explosions were 21 and 178, respectively, while the deaths from fall of roof and sides were 497 and 502.

The Witness believes that a universal compulsory system of watering roof, sides and floors, would largely increase the latter numbers, while there might be but a small decrease in the former numbers.

In certain seams (the Rhondda Four Feet Seam, for instance) watering must be conducted with great caution, on account of the friable roof and soft floor, and latter tending to heave after heavy watering. It has been said that after being watered for some time the floor does not heave ; that is not the experience of the witness.

In every case that he knows of water percolating through the roof in the steam coal measures, heavy falls have occurred, resulting in huge cavities, in which it has been extremely difficult to keep gas from accumulating. Watering the roof would tend to produce the same result.

He is moreover of the opinion that it is not necessary in any case to water the roof and sides. Wherever a road is damp from natural causes, no dust will be found on the sides. Many examples have been found in recent explosions where a damp floor has arrested the explosion.

If a general system of watering is adopted, a large number of mines will have to be dealt with by exemption (such as is provided by the German Mining Law) or not worked at all. The expense of working these seams with the cost of installation, plus maintenance of the watering system, in addition to the cost of extra repairs, will prove to be the last straw.

The Witness is of opinion that in such cases if watering is to be enforced the most efficient way will be to provide wet zones, consisting of arched roadways in which centrifugal sprays may be fixed, set to run intermittently, in conjunction with watering by means of hose manipulated by workmen, which latter method has been found to be the most practical so far. The arched road may be from 50 to 100 yards long, and may be made where circumstances permit, *e.g.*, outbye junctions of roads.

The idea of paving underground roadways is impracticable in South Wales, especially so where the effect of heave is so severely felt.

The cost of watering on German lines (but not roof and sides) would certainly reach 2d. per ton, and the heave which would certainly result therefrom would raise the cost of repairs another 2d. per ton, while the difficulty of keeping height on the roads for the horses would be accentuated.

He believes that the idea of keeping the roads in a "sloppy" state would be most detrimental to the horses, predisposing them to greasy heel and diseases of the hoof, while the passing from warm dry zones to cool sloppy zones would render them very liable to chills and bring their condition down.

In roads where the gradient is high it would be impossible to water, on account of the spragged wheels failing to grip the rails, and the danger to hauliers and their horses would be increased tenfold.

Attention should be drawn to the fact that colliers invariably demand monetary consideration for working in damp places, while if there is water dropping from the roof, it is difficult to get men to work there. In addition, the witness desires to point out that a ventilating current in the lower measures in the deepest pits, naturally warm, heavily charged with moisture, would be a most oppressive one to work in; and would certainly result in a lesser output per man.

ALTERNATIVE SCHEMES OF DEALING WITH DUST.

(7) The Witness is confident that arching and paving with bricks would never answer in South Wales. For instance, he knows of a length of stone arching 9 ft. wide by 9 ft. high by 2½ ft. thick on a main level not 200 yards from the shaft that has had to be renewed six times in eight years, the pressure crushing the Pennant stone into fragments, besides reducing the width. This will serve to indicate the impracticability of the above proposal.

He is convinced that a more exhaustive inquiry is still needed as to the character of different classes of coal dust, and is of the opinion that the true cause of dust explosions remains to be discovered, for mining engineers are by no means agreed that there has been an explosion of coal dust without being initiated by an explosion or detonation of some kind.

He believes that the firing of shots on any main haulage roads should be restricted as much as possible and accompanied by the strictest precautions. He would suggest that as much dust as can be removed shall be done, and the distance of 20 yards from the shot to be fired to be well watered.

The Witness believes that it will not be practical to legislate on this point owing to the varied conditions which accompany the working of mines.

12137. (*Chairman.*) You are a mining engineer and agent to Messrs. Locket's Merthyr Collieries ?—Yes.

12138. You have had 30 years' practical experience in mining, having commenced duties at the Cwm Avon Col-

Digitized by Google

lieries. Where are they situate?—In the Cwm Avon Valley, near Aberavon, in Glamorganshire.

12139. You served there as an assistant and head surveyor for seven years?—Yes.

12140. Then you were surveyor and under-manager at the Mardy and Pentre Collieries for 12 years. Where are those collieries?—Also in Glamorganshire.

12141. You were also colliery manager at Barcelona Nueva, Venezuela, for two years, and also at Glyn Colliery, Tonyrefail, for two years. Where is that colliery?—In Glamorganshire.

12142. You have been at the Mardy Collieries for four years, and during the last three years you have acted for Messrs. Locket's Merthyr Collieries as their agent and general manager?—Yes.

12143. You say you have had considerable experience in both inclined and horizontal coal measures, and you have for many years taken an active interest in the coal dust question?—Yes.

12144. You state that at the Mardy Collieries the question of watering was taken up seriously from 1877 onwards until by to-day there are upwards of 16,000 yards of pipes laid throughout the main haulages. Then your experience of watering is pretty extensive in one mine, at all events?—Yes.

12145. You say in paragraph 1 of your statement that there is considerable difficulty in classifying mines, as each seam is different. That, of course, one understands; but where part of a mine is extremely dry, of course you would treat that part as dry and dusty?—Exactly.

12146. So that although it might be difficult to classify any particular mine as being on the whole dry and dusty, or not dry and dusty, still you would have no difficulty at all in dealing with a particular seam as being a dry and dusty seam, as a rule?—I think I mention a little further on that a good deal depends upon the quality of the seam as well.

12147. Yes. Then you say that another variation may be noticed in both upcast and downcast pits, the downcast main roads being the most dusty as a rule. Do you find a great deal of difference?—Considerable difference between the two roads.

12148. You go on then to deal with the qualification of dust and causes of explosion in paragraph 2. You say that it is extremely difficult to indicate which class is explosive and which is not without a chemical analysis. Dealing with the question of chemical analysis, if you have an analysis of the coal dust you have no difficulty in deciding how explosive it is?—The same conditions occur again, that, if there is a large amount of debris carried out, there is an admixture of debris and fine dust from the coal: it all depends upon the ratio that the debris holds to the coal, whether it is innocuous or not.

12149. I suppose if the coal dust apart from the debris was of an extremely inflammable character, there must be more debris mixed with it to make it innocuous?—Exactly.

12150. Supposing you find by analysis that pure coal dust is of the most inflammable character possible, have you any idea, or have you carried out any experiments with a view to finding out what proportion of debris there must be mixed with it to render it innocuous?—We have not made any experiments going as far as that, but we have made considerable experiments many years ago—I think it must have been in 1887 or 1888. We tried then to find out ourselves in every way that we could, but we utterly failed. We collected dust from the upper timbers, from the in-bye and out-bye workings, from the screens and wherever we could get it, but we failed to fire it. We used no shot-firing, but we tried to fire it with a large flame from a "comet."

12151. Then you could not fire even the purest and most inflammable dust?—Not even the purest.

12152. Nor the finest?—Nor the finest.

12153. But that does not deal with the question at all of the admixture of debris: that is another question altogether?—Of course we had no means whatever of examining: we had never analysed this dust, and that is the reason why I say unless it is analysed it is impossible to say whether it is very explosive or inexplosive.

12154. Then I suppose you would say that the dust which you experimented with could not have been of the most explosive character or else you would have been able to explode it?—It is the dust which we found in our mine.

12155. But no dust which you found in your mine was capable of being exploded by a "comet"?—No.

12156. I say, therefore, that you have not gone yourself into the question of how much debris would be required to render dust innocuous, because so far as you are aware all this dust in your mine is innocuous, that is to say, it is innocuous as regards being fired by a safety lamp breaking or by a candle?—Yes.

12157. It could not originate an explosion, but it could only carry it on?—It could carry it on.

12158. With regard to it having carried it on, you have not gone into any experiments to show how much debris must be mixed with it to prevent it carrying on an explosion?—No, we have not gone into that.

12159. And you have no ideas on that subject?—I have no ideas on that subject.

12160. You have had explosions, no doubt, in your mine?—We had one serious explosion in 1885.

12161. And I suppose others less serious?—Never.

12162. Is that the only one?—That is the only one.

12163. Then that explosion showed clearly that the fine coal dust was capable of propagating an explosion?—Most decidedly so.

12164. There is no doubt about that?—No.

12165. Do you think that the coal dust which was raised by that explosion was pure coal dust, or was it mixed with debris?—That is a difficult matter to say, but I am convinced that there was a propagation of the explosion by coal dust.

12166. But you could not say how far that was pure coal dust or how far that coal dust may have been mixed with debris?—No, I could not say that.

12167. There may have been some mixed with it—you do not know?—I do not know.

12168. You have not made any experiments with shot-firing and, therefore, you cannot say whether fine coal dust alone, without any admixture of gas, could or could not cause an explosion by a blown-out shot?—No. We have made no experiments in that direction.

12169. Or how much debris would prevent an explosion?—No, we have made none in that direction.

12170. Then you deal with the ignition of the coal dust in a small coal hopper, which has been alluded to before: and you think it would be very difficult to reproduce those conditions in a mine gallery?—Most difficult. You have there pure coal being screened, and a very thick cloud of fine dust coming from it.

12171. Then, you think that no experiment can be rendered of any value with regard to that matter?—I do not think so.

12172. But you think that the explosion in a hopper is practically of no importance with regard to underground working, because you think that those particular conditions could not possibly exist underground?—That is so.

12173. In paragraph 3 of your statement you have no hesitation in saying that the most explosive dust will be found along the main haulage roads, where the velocity of the ventilating current is greatest, and from that point in-bye, especially so towards the inner half. I think we all agree that the greatest danger from explosion is in the case of a shot fired in the haulage roads?—That is one of the most dangerous places in the colliery.

12174. So that you consider that in the working faces, whatever fine dust there may be, it is such a very small quantity and so admixed with bigger dust and coarser dust that there is no danger practically of an explosion at the face?—There is no danger. Of course the velocity of the ventilating current is much less than what it is on the main engine planes, and the explosive dust is no doubt sifted by the strong current.

12175. So that it is deposited from time to time—as the current goes along the fine dust is deposited up above on the timbers, principally?—That is so.

12176. You find the fine dust not on the floor, but you find it mostly up above?—Up above.

12177. So that the greatest risk is in firing a shot at a considerable distance from the face?—That is so.

12178. Now, with regard to the sources of explosive dust, which is your next heading, first of all in (*a*) you deal with the question of the kind of tubs or trams that are used, and you say—in which everybody agrees, I think—that the escaping of small coal and dust through the

Digitized by Google

Mr. T. E. Richards.

7 Feb. 1907.

crevices and the ends of the trams causes a great deal of dust. Have you any suggestion to offer as to the construction of the trams? What trams do you use in your colliery?—Iron trams.

12179. Do your men object at all to iron trams?—I have not heard any objections from them.

12180. We have heard from one witness that the men strongly objected to a type of steel tram which he wanted them to use, and they said it was too heavy, so that he was obliged to use a wooden tram instead.

(*Mr. F. L. Davis.*) It has been the custom in Wales, I think, to use iron trams; it is not anything new to the Welsh miners?

(*Witness.*) No; it is not new.

12181. (*Chairman.*) Then there is no difficulty at all with regard to that?—No. We have a few wooden trams, but they are chiefly used for carrying very small rubbish and debris.

12182. But why should you use wooden trams for very small rubbish and debris?—Because we have at one end of the tram what we call cross-bars (we have no doors at one end of the tram), and those cross-bars, of course, would allow the small debris to run out on the roads. So that in such cases we have very close wooden trams for that purpose, which would take the carbonaceous shale that we may be compelled to fill out from a working place.

12183. Then those iron trams of yours are not dust-tight all round; they are only dust-tight on three sides?—Only on three sides.

12184. (*Mr. Wm. Abraham.*) But are they dust-tight on three sides?—Yes. Practically, speaking for my own colliery, of course, all the new trams are now being made of sheet steel complete—one end and the sides—completely up to the side of the tram; the only point which we have open now is the cross-bars, and those have been increased to two.

12185. What is the proportion of new trams which you use now as compared to the number which you use of the old type?—I should think three-fifths are steel trams. Further than that, every tram is being altered. We are taking off the old bars and replacing them with sheets so as to fill up those crevices between the bars. It is the general custom throughout South Wales to do this now.

12186. (*Chairman.*) But still, these new trams are only tight on three sides?—On three sides.

12187. Do you think that is desirable; do you not think they ought to be tight on all sides?—Well, that is being done also; we are changing the crossbars for doors.

12188. Do you mean flaps to let down?—No, doors turning upon hinges.

12189. From the side—not downwards?—From the side. Of course the general custom was to tip in front, and the utility of the crossbar was to let the coal go out in front of the tram, but with the new screens where there are tipplers turning a tram completely over, it can be perfectly encased now with a door.

12190. And that is very much better?—That is better.

12191. With regard to the screening of coal near the pit's mouth, do you think it would be desirable to do anything to prevent the dust from the screens going down the shafts?—I do not think so, because we have a case in point at Mardy. The screens at the downcast there have been removed to a totally enclosed shed, it may be 30 yards away, and I do not find the ventilation very much less dusty than it was before.

12192. You think it has made very little difference?—Very little difference.

12193. I suppose in some cases it might make a good deal of difference?—It might in some cases, but with us it made very little difference.

12194. Then you strongly advocate the use of steel tubs that are dust-tight on all four sides?—There would be less escape of small coal and dust if that is the case.

12195. Now you speak of dust and small particles of coal being blown off the trams in passing against the ventilating current. Would you deal with that in any way by prohibiting loading of coal over the sides of the trams?—If that was prohibited it would have a most important effect upon the coal trade in South Wales.

12196. Then how would you deal with it; would you deal with it by spraying the coal as it went by?—By spraying the coal as it starts from the double parting.

12197. In your collieries spraying the coal would not deteriorate it at all, would it?—Very little. The quantity of water that it would receive would not be sufficient to deteriorate it to any great extent.

12198. And you carry that system out in your collieries?—We carry it out.

12199. You say that what is obtained from the surface screening is a small amount. You mention that the dust on the main haulage roads from a dry thin seam may not always be explosive, because it may be so much mixed with innocuous dust?—Yes.

12200. As I understand, you have not carried out any experiments with a view to finding out what proportion of innocuous dust would be necessary in order to render coal dust inexplosive?—We have not.

12201. You have had so very little experience of explosion in your mines that there is not a great deal to go upon with regard to that?—No—and we do not wish any.

12202. No, I congratulate you. Then with regard to the prevention of accumulation of dust, you say it can be brought about by making the trams as dust-tight as practicable. That I have already asked you about. You say that the tops of the trams are packed from 12 to 18 ins. above the sides and ends?—Yes.

12203. And if there should be any small coal on the top the dust from that is dealt with by means of sprays?—Yes.

12204. As a rule would there be any small coal on the top?—Yes, generally there is. It is one of our greatest difficulties to prevent the collier from putting dust, one or two boxes of fine stuff, on the top of the tram. The colliers think it prevents the large coal from breaking.

12205. It is a sort of packing?—A sort of packing—a kind of cushion.

12206. (*Mr. Wm. Abraham.*) There cannot be much doubt about that, can there—that covering the top of the tram with coal dust would prevent the breaking of the large coal?—Well, it all depends upon the amount placed there. If they would just put one I would not say anything, but they put perhaps 20.

12207. But is there any doubt at all about the small coal helping to keep the large from breaking?—Not the least; but the quantity sometimes is excessive.

12208. (*Chairman.*) To some extent it has a beneficial effect, and prevents the large coal breaking up. Then you say you do not think it would be any good trying to cover the tubs?—I do not think so. I think that is hopelessly impracticable.

12209. There would be considerable difficulties. I suppose if the tubs are sprayed as they go along it would not be much good covering the tubs—there would be very little dust shaken out from them?—Yes.

12210. You say you do not agree with the vacuum collection of dust. What has been suggested to us with regard to the vacuum collection of dust is that, supposing you have a haulage way which is arched—brickwork—and you have a brick floor, or supposing the sides of the haulage way are made smooth with cement or some other material, then that part of the haulage roadway could be kept free from dust by a vacuum cleaner very easily?—I think I have dealt with the question of paving and arching further on in my statement.

12211. But I was asking you in connection with the vacuum cleaner; do you not think that would be a good way of rendering an arched way dustless?—I should think if it was kept perfectly dry it would be in a very bad state before the middle of the day following the cleaning. It would have to be constantly done, and in that I see the impracticability of it.

12212. I understand you have made some experiments with regard to keeping the haulage roads perfectly free from dust?—Yes, we are doing our best.

12213. I mean by sweeping, or by some means of that sort, quite irrespective of watering?—We clean the roads periodically by means of a shovel.

12214. You say that the experiments which have been made have proved to be a hopeless failure for the vacuum collection of dust. In what sort of haulage roads were those experiments made?—I believe you had a witness before you yesterday who spoke to that subject—Mr. Hodges. I heard him say he had tried the experiment himself in two or three places and that he failed to get it to work, and that he had to place the end of the pipe really on each separate spot of dust before he could get it in.

12215. That I suppose would be so in a haulage road

Digitized by Google

which had a lot of props and sprags standing about in all directions, but I was thinking of a road which was specially constructed so as to be easily cleaned and made smooth both with regard to the floor, the sides and the roof. Have you made any experiments on a road of that kind ?—Nothing of that kind.

12216. Then your experiments are simply with regard to the ordinary road ?—Yes, the ordinary road.

12217. You say that the periodical cleansing of dust and debris from the main and other roads is of considerable benefit. So that your system is partly to do away with the dust by watering and partly to do away with it by taking it away ?—Exactly.

12218. You deal with the subject of watering in paragraph 6 ; you say that a system of universal watering would be decidedly objectionable. Then you compare the deaths from explosions and the deaths from falls of roof and sides, and you show, as has been shown before the Commission previously, that the number of deaths from falls of roof and sides are very much larger than the number of deaths from explosions; and you consider that if there was universal watering the number of deaths from falls of roof and sides would increase ?—I firmly believe so.

12219. You have nothing specially to go upon in saying that ?—Yes, I should like to point to the second paragraph, in which I say that if watering is required by law, then the colliery manager has no option in the matter—he must do it and carry out the law whether he thinks it is safe to do so or not.

12220. In Germany, as Dr. Haldane will no doubt tell you, although they have a universal system of watering, still at the same time there are exceptions; and if one can show that a mine would be seriously damaged or rendered dangerous by watering, then one can get an exemption or partial exemption: and I do not suppose that anybody would suggest that there should be universal watering carried out in every mine. You think that the number of deaths from falls of roofs and sides would largely increase if there was universal watering: what do you go upon when you say that ?—I refer to deaths from the breaking of the roof.

12221. You have noticed, have you, that when you have water to any considerable extent, falls of roofs and sides are more likely to happen ?—Yes—not once, but on several occasions.

12222. That is your experience ?—Those are some of our most serious experiences in that direction.

12223. Have you any statistics which would show how many persons have been killed by falls of roofs and sides in wet seams, and how many have been killed in dry seams ; or, putting it in another way, how many persons have been killed from falls of roofs and sides in seams where watering has been carried out, and, on the other hand, where watering has not been carried out ?—We have no statistics of that kind: it is only from our general experience.

12224. You are quite sure from your general experience that falls of roofs and sides are more numerous and that the deaths are more numerous where the seams are wet or are watered ?—Where the top is watered. Wherever we have water, even only percolating through the roof, it always adds to the cost of timbering 200 per cent., and even 300 per cent.

12225. It might add to the cost, but if the danger is well known and is provided against, it may not add to the danger ?—With regard to the sides, you have no means of judging: you water the sides and the sides slack away on account of the friability of the stone ; the same stone is used for packing the sides as the roof, and in many cases it is so friable that both sides and top may give way without your knowing it.

12226. So that, notwithstanding every precaution you can take, you consider that either natural or artificial watering of the sides and roof does make a seam more dangerous to work ?—Yes, very much so.

12227. You have no statistics, but you go upon your general experience as regards that ?—Yes.

12228. But you say that to water the floor only would do no harm, except I suppose where the floor heaves ?—Except that it brings a considerable amount of heave.

12229. And where it brings a considerable amount of heave you have to have a considerable amount of ripping of the roof to make up for it ?—Exactly—and cutting the bottom.

12230-1. With regard to watering the floor only, do you think that a wet floor would be sufficient to stop an explosion ?—I believe that to be so ; we have several instances in recent explosions which have tended to prove that.

12232. What explosions do you allude to ?—I think you will find there is one case, if not two, in the Albion.

12233. Cases where an explosion was stopped by a wet roadway ?—I believe so.

12234. Although the sides and the roof were quite dry ?—Yes ; the explosion passed up to a certain district and stopped where it was naturally wet.

12235. (*Dr. Haldane.*) That was the Pant Ddu dip in the Albion explosion, was it not ?—That is so.

12236. (*Chairman.*) Were the roof and sides dusty where it stopped ?—I have never seen a naturally damp floor with dust on the roof.

12237. Do you mean to say that by damping the floor you can prevent the dust settling on the roof ?—It has not the tendency to rise.

12238. Then comparatively very little would rise ?—Comparatively very little.

12239. The tendency with regard to any dust that would get up above would be for it to be blown away by the air current, and directly it was blown away it would in the course of time settle on the floor ?—If you have it sprayed before it starts out it is very unlikely to get blown away.

12240. So that in your opinion if you water the floor it is almost as good as if you watered the sides and the roof as well ?—That is what I believe.

12241. You think there is hardly any difference. Even if you had wet zones, would you consider it sufficient to water the floor only ?—Quite so.

12242. And you think that would stop an explosion ?—It would be quite enough.

12243. Then you might combine the watering of the floor with a system of sweeping the dust so that, if when you began watering the floor again it was dry and you found that there was an accumulation of dust above, you might bring that dust down by some means to the floor by brushing or by some appliance ?—If we did that I am afraid we should bring no coal out, because as soon as you start working the dust begins to settle at once, more or less. Whatever process was adopted it would be practically impossible to ensure that the place would be perfectly free from dust ; you may say it would be practically free from dust, but it would never be absolutely free from dust.

12244. Mr. Ellis has called my attention to the 7th paragraph of the heading we are now upon in your statement, in which you say that wherever a road is damp from natural causes no dust is to be found on the sides ; but my question rather went to this, that you might have a system of watering the floor but that system might not be properly carried out, and although you watered the floor on one day, the watering might dry up and the floor might be dry for a certain number of hours, we will say, during which time the dust might collect above ; so that it seems to me that if you thought that you might deal with a stopping zone, partly by watering and partly by dusting in that case, if you only watered the floor and the roadway was naturally perfectly dry it might so happen that your artificial watering would not be sufficient and that the floor might dry up before you began to water it again, and that during the time it was dry some dust might accumulate above. Then if you found dust accumulating above, you could deal with it by brushing or by syringing, or in some way as well as dealing with the floor ?—Wherever dust is we make an endeavour to get it from there somehow or other.

12245. Yes, of course, nobody can be perfectly certain that their orders are always exactly carried out, or that what is done will be absolutely efficacious in the case of artificial watering. It may be that you might make a mistake and that the whole of the watering might dry up before you began watering again. That is my point ?—Yes.

12246. In that case, if that was so, you could deal with that probably, so that if at the same time as you watered you found that that part of the haulage road was dry and dusty, you could deal with it not only by watering the floor but also by bringing down any accumulation of dust that formed above ?—Yes, that could be done.

12247. You think that if this artificial watering was properly carried into effect, and perhaps combined when necessary with clearing away the dust, that would be just as efficacious in stopping an explosion as if you had the

Digitized by Google

Mr. T. E. Richards.

7 Feb. 1907.

whole place thoroughly watered?—Of course, there are exceptions, even in watering. I wish to press that most emphatically.

12248. You mean cases where you cannot water at all?—Cases in which I have been prevented completely from watering, although I have the pipes there—cases in which I dare not water. I have one dip in which, until we commenced watering it, there was very little heave or pressure or creep: but as soon as we wanted to do some firing in-bye I wanted to have the place watered, and because we have watered it I have had to cut bottom something like 1 ft. to 18 ins. thick three times within the last 18 months to keep places even for the horses to go in.

12249. You mean that even if you were to arch it, the arch would not stand?—The arches would not stand, because I have two arches there and they are practically crushed in less than 18 months.

12250. So that there are places where you cannot water at all?—There are places where you cannot water at all.

12251. You deal with those cases, I suppose, by sweeping the dust away?—As much as ever we can. We have to dig it away because the heave is so much that we have to cut the bottom from there.

12252. Supposing you manage to keep it fairly free from dust: do you think a fairly dustless zone would be as efficacious in stopping an explosion as a watered zone? Have you any experience of that?—I have no experience of such a case. I believe the water has a tendency to damp the air, and in a dry arch, paved as is suggested, I do not think it would have that effect.

12253. So that you think a dry, paved arch, even if it was swept very clean from dust, would not have quite the same effect in stopping an explosion as a wet zone?—That is my opinion.

12254. So that if you had a dry zone with a view of stopping an explosion, that dry zone would have to be a great deal longer probably than the wet zone would have to be?—I believe so.

12255. And if 100 yards of wet zone would stop an explosion, probably it would take 200 yards of dry zone to stop it?—Most probably.

12256. It has been suggested that the underground roadways should be paved: you say that cannot be done in South Wales because the roadway will creep?—Exactly: and I give you an instance of that further on.

12257. Now as to the cost of watering, you say that it would certainly reach 2d. per ton, and that the heave which would result would raise the cost of repairs another 2d. per ton—that is 4d.; while the difficulty of keeping height on the roads for the horses would be accentuated. Mr. Gray gave evidence on that point before us, on November 28th, 1906, and at Question 8363, in answer to Mr. Cunynghame, he gave a statement of the cost of an installation of watering in actual use in a steam coal colliery; he gave the cost at £1,273 11s. 10d., and then added "The cost of watering roads and the maintenance of water pipes works out about ·20d. per ton of coal drawn." I do not know whether your attention has been drawn to that?—Yes.

12258. Where the expense of setting up a system of watering was only one-fifth of a penny per ton?—But I believe Mr. Gray is in error there in stating that the whole of the colliery was done for that.

12259. (*Mr. F. L. Davis.*) We do not know from Mr. Gray what the size of that particular colliery was, whether it was a new one or an old one, or what amount of coal was drawn from it. It would be very difficult to estimate what the cost would be from that evidence?—Exactly.

12260-1. (*Chairman.*) Your experience is that one-fifth of a penny per ton is not sufficient?—I believe that the cost which is alluded to there does not include the watering of the whole colliery.

12262. Then Mr. Gray went on to say this in answer to the next question by Mr. Cunynghame: "(Q.) That is a very favourable and cheap instance of watering. There are others which would be a good deal more expensive than that. (A.) In that case"—I suppose that means in other cases—"I do not think it would exceed ½d."—you think it would be 2d.—four times as much as Mr. Gray thinks it would be?—Yes, to water according to German lines it would cost at least 2d.

12263. (*Dr. Haldane.*) Do you include in the estimate watering the whole mine, as they do in Germany—the face and the return roads as well as the intakes?—That is what I mean—watering on German lines, but not roof and sides.

12264. That is watering the whole mine?—Yes.

12265. (*Chairman.*) When you gave the figure of 2d., did you mean complete watering of the mine, or only zone watering?—Complete watering of the mine.

12266-7. But supposing you only had to water in zones of say 100 yards at certain intervals—of course one would have to settle what the intervals would be and where you would have those zones—that would be very much less expensive?—Very much less expensive. What I understand by watering as they water a German mine (I have not seen them, but it is only from what I have read in the report made to the Commission) is that we must have a ramification of pipes all through the colliery, watering working faces, horse haulage, mechanical haulage and returns.

12268. Your calculation is on the calculation of universal watering as it is carried out in German mines, or as you understand it is carried out in German mines?—That is so, the pipes carried into every working place and road.

12269. Mr. Gray made a statement with regard to an installation in actual use, and he went into details as to the £1,273; he said, for instance, there were 15,775 yards of 1½ in. diameter pipes amounting to £1,035 11s. and so on, so that he did go into the matter?—Yes.

12270-4. However, notwithstanding that in this instance in this particular part of the colliery it only worked out at one-fifth of a penny per ton, none the less you are of opinion that a similar system put in force throughout the colliery would cost about 2d.?—Yes.

12275. (*Dr. Haldane.*) Are you including in that estimate the return roads and the working face?—I include, of course, taking the water up to the working faces so as to be able to water them.

12276. But we should like to have some sort of information as to what it would cost to water the roads used for haulage only without watering the working face and without watering the returns. Could you give us a rough sort of notion?—No, I have not gone into those figures, and I cannot give them.

12277. But that would be a good deal less than what you have told us?—That would be somewhat less.

12278. Well, a good deal less, surely?—Do you mean watering the engine planes and the haulage roads?

12279. Yes, up to near the face?—That would be practically what I mean, because I do not know whether it is suggested that you would water through the working faces.

12280. I thought you said that just now?—No, I do not think so. I said up to the working faces—to carry the water up to them so that it can be utilised at the working faces.

12281. (*Mr. Ratcliffe Ellis.*) Have you to buy the water?—Oh, no, it simply percolates through the strata down to the lodge room and we take it from there.

12282. (*Chairman.*) Still, if you have the faces and the engine planes watered in zones you would have to carry the water by pipes?—Yes.

12283. Do you think that it would make a very great difference whether you water the haulage roads by zones all through?—If you take watering by zones and not the whole of the mine, it would mean considerably less cost to water zones than to water the whole colliery.

12284. But you would have to have the same length of pipe?—Exactly; the installation would be exactly the same.

12285-90. But the cost of working would be very much less?—Yes.

(*Mr. Ratcliffe Ellis.*) Still, the main cost is in the cost of pipes; it is £1,035 for pipes as against a total of £1,273.

(*Chairman.*) Yes, exactly; but the whole of those pipes only come to one-fifth of a penny per ton.

(*Mr. Ratcliffe Ellis.*) I suppose he has taken that throughout the entire output of the colliery?

(*Witness.*) Yes, I think so.

12291. Then you go on to deal with the notion that roads might be kept in a sloppy state with advantage, and you say that if they were kept in such a sloppy state it would be most detrimental to the horses, predisposing them to greasy heel and diseases of the hoof, and that passing from warm, dry zones to cool, sloppy zones would render them very liable to chills and bring down their condition. Therefore you think the floor ought only to be watered to

Digitized by Google

the extent that is required to stop the dust?—That is the point I desire to emphasize.

12292. And that any further watering would be detrimental to the horses, and also, I suppose, to the men, to some extent?—Exactly. I have one pit in which there is natural water, and the horses there suffer considerably from predisposition to greasy heel and diseases of the hoof.

12293. Then I suppose you try to lead off as much of the water as you can?—Yes—we have to fill it away.

12294. You say that in roads where the gradients are high it would be impossible to water, on account of the spragged wheels failing to grip the rails. Do you mean that the wheels have to be kept dry in order that they should grip the rails?—We dare not water such roads, because in some cases where the gradient is 6 in. in the yard you have to sprag the wheels, and if there should be any water on the rails it may mean sometimes death to the horse and perhaps to the haulier.

12295. You mean it makes it too slippery?—Too slippery—the wheels do not grip the rails at all.

12296. Do you find that the health of the colliers suffers from working in damp places?—No, but very little. We have but very little experience of it; it is only occasional, and we cannot say as to that.

12297. So far as your experience goes, the colliers working in damp places are not more subject to rheumatism than colliers working in other places not so damp?—I do not think so. You find healthy men in the house-coal measures which are damp.

12298. (*Mr. Wm. Abraham.*) Have you any experience of paying men extra because of their having to work in places which have been sprayed, or made wet artificially?—Not places made wet artificially.

(*Mr. Wm. Abraham.*) Then that does not bear upon the question.

(*Chairman.*) No, it is only with regard to places that are naturally damp that you say that.

(*Witness.*) It is simply in local places in which the water is percolating through the roof.

12299. Yes; but no collier has ever suggested that his health is impaired or that he ought to have special money because of working in sprays or where there is artificial watering?—Not where artificial watering takes place.

12300. You say that a ventilating current in the lowest measures in the deepest pits, being naturally warm and heavily charged with moisture, would be a most oppressive one to work in. That one can understand; but then, on the other hand, supposing you are in a very deep and very hot seam, it has been suggested—and in fact it is certain—that the watering cools the air, so that although you have the atmosphere damper you also have it cooler by reason of the watering?—I could not say that I have found that to be so in one of the deepest pits in Belgium.

12301. You found that watering a very deep pit made it much more difficult to work, and much more oppressive?—Much more oppressive.

12302. Then you say that arching and paving with bricks would never answer in South Wales. With regard to that you have already said that the pressure crushes the stone, and that it cannot be done. Would that apply to most of the mines in South Wales—that you could not have stone arching?—What I wish to point out is this, that I do not see how we are going to get arching with stability sufficient to carry out the suggestion which is made, because in less than two or three months' time whatever mortar is plastered on the walls will be down.

12303. But does that apply to every mine and every seam in Wales?—I think so.

12304. You think that there is hardly a seam in Wales in which that is not so?—With the exception of the house-coal seams. I have one in which I could leave an arch, I think, for five years without renewing it, and that is about the only one. That is what we call the Abergorky Seam, which is a semi-house coal seam.

12305. You go on to say that you think it is very necessary that experiments should be made as to the character of different classes of coal dust, and you think that the true cause of dust explosions remains to be discovered, because mining engineers are by no means agreed that there has been an explosion of coal dust without it being initiated by an explosion or detonation of some kind. That would be so, excepting that there is no doubt, with regard to the explosion in the hopper, that it was caused by a light only?—Exactly.

12306. So that under certain circumstances—circumstances which you say can hardly occur underground—there may be explosions simply of coal dust caused by nothing else than a light?—Yes.

12307. But practically underground you do not know that that has been proved?—I may say that almost the whole body of South Wales Colliery officials are practically agreed on that point.

12308. That is to say, they do not think that an explosion of coal dust can take place without that condition of things?—They do not think that an explosion of coal dust can take place without having detonation of some kind.

12309. Then you think that the firing of shots on the main haulage road should be restricted as much as possible and accompanied by the strictest precautions. You would suggest that as much dust as can be removed should be removed?—Yes.

12310. Therefore you think it is not sufficient to carry into effect the present Rule which requires watering, but that even where you do water you ought in the first place to remove the dust before watering?—If there is any dust there I think it should be removed.

12311. We had in evidence a case where the explosion seemed to be caused by the dust having been driven out by the shot from a crevice or something more than a crevice, I suppose—some considerable cavity. I do not know whether by any system of blowing out the dust you could have removed that? I suppose it is possible that if that shot-hole before it had been watered around had been dusted by, say, a dry air syringe, or something of that sort, that dust might have been driven out. But I suppose sometimes there would be cavities close to the shot, and if the shot is blown out the dust will be scattered by the explosion—dust which you cannot possibly get at?—That is so. It would be perfectly possible that you could have, not perhaps exactly where you are putting a shot (because if there were cavities that would show that the top was so weak that it would have to be timbered), but it is perfectly possible that some 50 yards away some fall might have taken place and you might have timbers, and on the top of that packing of timbers you would have dust which no watering of any kind could reach.

12312. But in this particular case it would appear that there was some cavity close to the shot which was fired—a cavity containing coal dust—and that that coal dust was very much disturbed by the blown-out shot, and that the blown-out shot fired the coal dust and caused the explosion close by the cavity containing the coal dust, as I understand it. That might be, I suppose?—I cannot quite see how that could occur with the same shot. If you mean that it went with the same shot, I do not see how it could occur.

12313. I understand the theory is that this was a blown-out shot, and that the blown-out shot naturally produced a great commotion in the air, and that the commotion in the air drove into the air a vast quantity of coal dust which was concealed in the cavity close by the shot. However, that seems to have been so: but you say you do not quite understand how that could have occurred?—No.

12314. (*Mr. Ratcliffe Ellis.*) You say that the blown-out shot liberates the dust, but that the mischief of the shot would have gone before the dust could have been fired?—Yes, before the dust could have been fired.

12315. (*Chairman.*) You go on to say that you do not think it is practicable to legislate on this point, owing to the varied conditions which accompany the working of mines. I suppose you refer to the point as to the firing of shots on main haulage roads, or do you mean on the general point of watering?—The general point of watering.

12316. You do not think that any general rule could be laid down which would be applicable to all the mines in the United Kingdom with regard to watering?—I do not see how that could be done.

12317-8. But might there not be a requirement, say, that there should be some system of zone watering, or that in default of zone watering there should be a method of clearing away the dust, or something of that sort?—No doubt attention should be drawn to the fact that dust requires removing, and that it is necessary to do the best you can with watering; but it would be a difficult matter to lay down any rule, because whatever you might lay down it would be inapplicable to some seams and applicable to other seams.

12319. Perhaps the Legislature might be equal to dealing with various classes of mines?—Probably.

12320. At all events, you do not suggest any particular

Digitized by Google

Mr. T. E. Richards.

7 Feb. 1907.

form of legislation. What struck me with regard to the evidence given by the Inspectors of Mines was that I think there was not a single Inspector of Mines who did not say that on the whole watering was not sufficiently carried out. I think every Inspector of Mines said that, in his opinion, if you only looked to the safety of the miners and not to the cost of working, it would be desirable that more watering should take place than did take place. You would not be inclined to agree with that?—I should not be inclined to agree with that.

12321. As regards the South Wales District, at all events in the part that you know, you consider watering is carried out quite sufficiently?—I believe that to be so.

12322. (*Mr. Cunynghame.*) A witness who appeared before us said that there was not much dust at the working faces, but that at the working faces the small coal was more of a gravelly nature, as I gathered?—That is so.

12323. You would agree with that?—Yes.

12324. If that is so, I do not see what good your proposal would be of spraying the tubs before they leave the working face, because it would only be spraying not dust but fine gravel, shall I call it?—I do not think I have made myself perfectly understood. The spraying of the tram that I allude to is spraying when it leaves the double parting, not the working face.

12325. Now I understand you. You naturally advocate also tight wagons as much as possible, to prevent the scattering of this gravel and dust on the roadways?—The less leakage there is the better.

12326. I suppose it is your view also that a good deal of this which I have termed gravel, in a sandy condition, gets trodden into dust in the great main roads?—That is so.

12327. But what I do not quite understand—perhaps you can make it clearer—is this: that if you have dry zones brushed through frequently, still there will be a great liability of dust coming in and continuing to come in from the districts around them by means of the ventilation, for instance. Would there not always be that danger? Let me make my point quite clear. If you had a dry, dustless zone, would not the dust be constantly coming in from the dusty zones around it?—That is quite possible.

12328. But that rather minimises, does it not, the value of a dry, dustless zone, and tends to show that it will not be so good if that argument is pushed far?—I have already said that I do not believe in dry, dustless zones.

12329-400. You want a wet zone?—I think of the two the wet zone is preferable.

12401. (*Mr. Ratcliffe Ellis.*) Yes. Now we will go to the question of dust. Do you find that the character of the dust varies with different mines?—It does.

12402. In connection with some mines do you find it more explosive than others?—Yes, some are more explosive than others.

12403. Does your experience go to this, that you could name the particular seams which make dust less explosive than other seams?—Well, I could not do that.

12404. Do you think it would be possible by experiments to get information of that kind?—I think it could be obtained.

12405. Do you think it would be desirable?—I think it would be extremely desirable.

12406. With reference to dust at the face, is that fine dust generally?—No—coarse.

12407. Will you look at this specimen of dust (*producing small bottle containing sample and handing same to Witness*). Is that something like the dust you usually find at the face?—That is from the face.

12408. Is there any harm about that dust; is it injurious?—Not at all.

12409. Would there be any risk of that dust either continuing an explosion or starting an explosion?—No, not at all.

12410. It is the very fine dust that is dangerous?—The very fine dust.

12411. Now will you look at this second sample (*sample handed to Witness*). That is a more dangerous quality of dust?—Yes.

12412. And that is the sort of dust that you would have to guard against?—This is very fine dust, but I think some could be found almost finer than that. That is inside the timbers.

12413. Your view appears to be that you cannot fire any dust by applying a light to it?—No, not in my opinion.

12414. Then you think that in order to have a dust explosion in a mine there must be some gas?—Some gas or a blown-out shot.

12415. There must be concussion?—There must be detonation of some kind.

12416. The experiment which has been suggested of firing it at the screen you do not think has any bearing upon the question?—Well, I may say this, that I have used "comets" myself; I have seen them burning for 20 years; and I have fires to-day at our screens: it is almost impossible to stop the men from using a fire. We try to get the men to do without it; but they will insist, when a person's back is turned, upon taking a little bucket of coal to burn to warm their hands, and sometimes the whole place is one cloud of dust, but you never see any signs of flame, although we have about the screens a far worse cloud of dust than underground.

12417-8. (*Chairman.*) Perhaps you had better state what a "comet" is?—It is what you may call a very large teapot with a wick in the spout.

12419. (*Mr. Ratcliffe Ellis.*) Do you think there is plenty of dust in a mine beside the coal dust?—There is.

12420. Do you think there is any dust which is dangerous except the coal dust?—I do not think any dust except coal dust is dangerous, because there is a certain amount of silica and alumina in other dust.

12421. That does not assist an explosion at all?—It does not assist an explosion.

12422. It rather tends to lessen the danger of the other dust?—It does.

12423. How do you fire your shots, during the shifts?—Not during the shifts, with the exception of some special hard heading work.

12424. You do not fire them during the shifts at the coal face?—No, not at all.

12425. But you fire them there between the shifts?—We fire them there between the shifts.

12426. Are they fired electrically?—Yes.

12427. Have you horses down the pit for the haulage?—Yes.

12428. Do you find that the travelling of the horses and ponies along the haulage roads is likely to lessen the dangerous character of the coal dust which might be deposited there?—Yes, because it is churned up with other dust.

12429. Mixing it with harmless dust renders the dangerous character of the coal dust less dangerous?—It does.

12430. You do not think there is a very large amount going down the shafts?—Very little. I believe there is more really blown off the trams in the shaft, while being raised.

12431. Therefore, do you consider it would be necessary to take any precautions on the surface to prevent the accumulation of dust from that source?—I do not think it would improve my colliery at all.

12432. You do not think that the quantity is so considerable as to justify any alteration of the surface arrangements?—No.

12433. Have you had an opportunity of noticing whether you have less dust down below where you have used steel wagons than you had before you used them?—We have less dust since we have been using closer wagons. There used to be the top crossbar about 3½ in. wide; then there was a distance of, say, 3 to 4 in.; then there was another strap from 3 to 4 in. wide; then another gap of 2 in. wide, and then a bottom plate, a vertical plate of a foot. Now we have taken away all those distances between the bars and use one sheet.

12434. Your experience since you have adopted the closer tub has been that you have had less dust?—Less dust and less need to clean the roads.

12435. Now, looking at it for a moment from a commercial point of view, do you find that it is any disadvantage to have those closer tubs?—No, not at all.

12436. So that without any loss commercially, you get an advantage by having your place clear of dust and by having less expense in clearing the roads?—Exactly.

12437. You say in your statement that you clean the dust away from your roads and that the periodical cleansing of dust and debris from the main and other roads is of considerable benefit in the prevention of any accumulation of dust. How often do you clean your roads?—If it is wanted, we do it in the night shift: we clean some

Digitized by Google

parts of the road nightly, and especially on Saturday afternoons.

12438. But have you any regular periods ?—No, they are simply cleansed as necessity arises.

12439. What is the necessity which leads you to clean them ?—When we see the roads getting dusty and dirty we send some men to fill up the dust.

12440. Is that having regard to the danger of the dust, or is it in order to facilitate the traffic along the haulage roads ?—Both reasons influence us to clear it off.

12441. Can you give us any idea of how often you have to do it in order to keep it fairly clear ?—I may say that the whole of the engine-planes are cleared, say, every two weeks.

12442. You cannot clear the whole of the dust away ?—No: we simply clear the floors and get as much as we can down.

12443. How do you get it down ?—We have been using besoms.

12444. Is there any other way of doing it ?—There is no other way.

12445. Then until you used besoms, how did you do it ?—We simply had to leave it alone.

12446. It was not done at all, I suppose, then ?—No.

12447. But now it is your practice, as part of the discipline of the mine, that the dust has to be swept periodically, so far as you can sweep the roof and the sides, and put into a tub, I suppose, and brought to the surface ?—Yes, brought to the surface.

12448. That is a practice which you would recommend, I suppose ?—I would recommend that.

12449. Is it very expensive ?—It is expensive.

12450. Does it mean more labour ?—It does mean more labour.

12451. Is it done by the ordinary repairing shift, or do you have to increase the number of repairers ?—Since the question of dust has arisen of course the cost of keeping the roads clean has increased very considerably.

12452. Have you any idea of the cost, so that you could put a figure for it ?—It would be rather difficult to put a figure upon it, but I should certainly say about ½d. per ton.

12453. It has put about ½d. per ton upon your cost ?—Yes.

12454. The change has been going on gradually ?—The change has been going on gradually—since 1887.

12455 Has it only been ½d. per ton since 1887 ?—Yes, constantly.

12456. Then that has been a very gradual advance. Is yours a dry and dusty mine ?—It is.

12457. You have water in it, apparently ?—Yes.

12458. Where is that ?—Wherever you get any synclines you often find water percolating through. We have one or two, and it comes through there.

12459. How many seams are you working ?—Eleven altogether.

12460. Is this dust cleaning done in all the seams ?—In all the seams.

12461. And the watering is done in all the seams ?—Of course, we have in some districts three seams worked off one engine-plane.

12462. I understand. Now universal watering you disapprove of, that is to say, the German system ?—I disapprove of that.

12463. In your experience in South Wales would there be many exceptions, if there was universal watering, that would have to be made ?—I am afraid there would be.

12464. More exceptions than collieries where it could be complied with ?—I believe so.

12465. The exceptions would be the greater number, you think ?—They would be.

12466. What is the depth of your deepest seam ?—426 yards we are working at now.

12467. Is that the seam in which you say you cannot keep an arch up ?—Yes, that is the one.

12468. Have you had any experience of mines double that depth ?—No, I have had none.

12469. Or of deeper mines ?—No, I have had none: that is the deepest.

12470. Do you think it would be possible in a mine 700 or 800 yards deep, or even deeper than that, to keep an arch up at all: could it be constructed in such a way as that it would stand the enormous pressure put upon it ?—It would be perfectly impossible, without giving way in time.

12471. So that you find it difficult in a mine 400 yards deep: in a mine deeper than that do you think it would be absolutely impossible to maintain any masonry or any construction that would stand up ?—It would not stand without crushing.

12472. It would crush ?—Yes.

12473. Is it also a fact that the mines which will have to be got in the future will be deeper than those which have hitherto been won ?—No doubt.

12474. So that the difficulty of building anything below is almost insuperable ?—It is.

12475. Would it be possible, except if there is some sort of construction in the shape of a tunnel with the roof and sides practically smooth, to clear an ordinary road of dust ?—It is perfectly impossible to do it.

12476. So that you could not clear it ?—You could not clear it.

12477. In some mines the difficulty of watering is equally insuperable ?—It is so.

12478. Have you any remedy to suggest, in cases where you can neither water nor effectively remove the dust, so that it could be rendered less dangerous than it is ?—The only way then is to try and remove the dust, as I said before, by simply getting it from there—by shovelling it. I can give you an instance in which we have had the misfortune of having some water breaking through from a seam above, and it has raised the cost considerably. We have had to fill that water into tanks and take it from that spot out to the pit bottom, and it has increased the repairs in that one seam in one district from 7d. up to 1s. 3d. per ton—simply the water which is leaking from the casks as the horses draw them along to the double parting and from there to the pit. One portion of that roadway was a hard heading, and we never had any trouble with it until this water was drawn over it: since then we have had to re-open that twice in the last 18 months. I am only giving a concrete example of water we have had to deal with: the roadway is constantly damp from the splashing of the casks, and that is the result of it.

12479. You recognise, of course, that there is a considerable danger from the existence of coal dust underground ?—I do.

12480. Have you considered any remedy, in cases where it could neither be watered nor effectively removed, to minimise the danger ?—No, I have not taken that into consideration.

12481. Do you think anything could be done in the way of regulating the shot-firing a little more strictly ?—I do not think anything can be done more than we are doing ourselves to regulate it.

12482. Perhaps you are in advance of the age. You are not firing in the coal or in the stone or anywhere else, except between shifts, apparently ?—We fire no shot in the coal, but simply in the top: and that is limited between the shifts, the day and the night shifts; very little is done in the morning: and we have our own officials to do it.

12483. You had an explosion at one time ?—We had one, I am sorry to say.

12484. How long ago is that ?—It was in 1885.

12485. Your present practices I suppose were not in vogue then ?—No.

12486. What was the cause of the explosion ?—It was a doubtful matter as to where it arose, and the Coroner's Jury never came to a decision with regard to where it originated. It was a pure engine-plane accident: it never reached any of the faces and everybody who kept away from the engine-plane came out alive.

12487. I want to see whether you can suggest any means from your experience by which the danger of this coal dust, in cases where it is impracticable either to render it harmless by watering or by removing it altogether, can be minimised. The danger is in the mechanical haulage roads ?—The danger is in the mechanical haulage roads: that is the source, I believe.

12488. Why is that the dangerous place ?—Simply because the dust there is of the most explosive character,

Digitized by Google

Mr. T. E. Richards.

7 Feb. 1907.

being so fine. You can feel *this* dust between your fingers (*referring to sample*). But there is dust to be found in the upper timbers on the laggings, above the collars, above the boards, which is so smooth and impalpable that you cannot feel it between your two fingers.

12489. I understand that is where the dangerous dust lies, but where is the danger that is likely to cause an explosion which might make that dust injurious ? Would you say that the face was a comparatively safe place ?—I think it is one of the safest places in the colliery now.

12490. And you think that there would have to be a blown out shot or an explosion of gas in order to cause the dust to explode at all ?—I am of that opinion.

12491. You say that you fire during the night between the shifts ; and you comply with the requirements as to watering, I suppose ; and you fire with permitted explosives ?—Yes.

12492. Can you suggest anything in addition to the present Regulations with reference to firing shots, in which you think there might be an improvement, and by which safety might be more secured ?—No, I think the present Regulations are quite sufficient. If the place is free from gas and water, I have not the slightest hesitation in firing as many shots as you ask me to.

12493. And you, being competent people, take care that it is free from gas before you do fire a shot ?—We do.

12494. It has been suggested to the Commission that, if there was a provision that no shot should be fired in a haulage road without the sanction of the manager, that the question should be brought before him and he should consider it and order it under such conditions as he should think fit—that might be an additional safeguard ?—That is a Rule which I have had in existence for the last six years—that not a single shot should be fired on any engine-plane without my own personal consent.

12495. Do you think that is a Rule which might be made a General Rule ?—I think it should be made a General Rule to that extent.

12496. And that would be the only addition which you think would be necessary to the present Rules as to shot-firing ?—I think that would be quite sufficient.

12497. (*Mr. W. Abraham.*) Mr. Ellis has very clearly put to you what I have in my mind. You have said in your examination-in-chief and cross-examination that there is dust in existence, so that when an explosion has occurred that will extend that explosion into various parts of the colliery ?—That is so.

12498. The point is this : Have you as a practical engineer any suggestion to make as to how that extension is to be prevented ?—I will give you a case in point. We have along the 4 ft. engine-plane, as you know as well as I do, a very bad top which has to be timbered well ; we have timbers set there as close to one another as they possibly can be, and we have over those timbers in many cases cavities which have been filled with dust, and it is impossible to get that dust from there without pulling all the timbers down. How to get that dust I do not know and I do not see any means of getting it. There is that dust there, and my own suggestion is that the place adjacent to the shot fired upon an engine-plane should be well watered in every way for 20 yards, and the dust removed as much as possible from there. I think in that case you are limiting the danger to the lowest possible that it can be.

12499. But coming back to the point again, have you any suggestion to make as to an effective way of preventing an explosion extending from one district to another ?—I would simply say, as I said before, that watered zones would be as effective as anything.

12500. In your opinion a watery zone is more effective than a dry zone ?—Yes.

12501. In your opinion also, a watery zone would be effective to prevent the extension of explosions from one district to another ?—It would have a tendency to prevent them extending.

12502. It is time we should have something definite now. You think it is possible to have some improvement in Special Rules, or something to better the conditions and to have more safety than we have ?—The more safe we make the mine the better for everybody.

12503. Do you think it is possible to get more safety than there is ?—Well, accidents will happen where you cannot possibly even account for them.

12504. It strikes me very forcibly that the burthen of your evidence is of a negative character. You will be aware that the object of this Inquiry is to try and find out some means of preventing accidents in mines ?—That is so.

12505. Then knowing you as I do and knowing your practice, I want to have some definite information from you with regard to how the object of this Commission is to be attained. Can you help us in any way or do you think we are now enjoying the best possible condition of things ?—What I say is this, that I believe in watering, but that watering must be left to the discretion of the manager to do it where he possibly can do so with the best advantage. That in some cases it may be very disadvantageous to him and in others he can do it well.

12506. You have had some experience of South Wales and you have seen a number of mines in South Wales yourself ?—I have.

12507. Have you noticed whether the same care is being taken with regard to watering and with regard to clearing the dust from the roads by using besoms, brooms and so forth, in other collieries as you say is done at Mardy ?—Well, I am not there and, of course, I do not know what their general practice is at all.

12508. But have you seen any indication of it ?—I cannot say that I have had more than very little experience of other collieries except the ones I have been looking after.

12509. But I put the question to you ; you have been there, and I know you have been there. How general in Wales is the custom of using besoms to sweep the roads ?—I would not say to sweep the roads ; I do not think I said that in my evidence.

12510. To sweep the sides ?—What I said was, that when we get dust in the roof and we want to get it down from there we have been using besoms.

12511. What is your own plan of removing the dust ?—Watering, chiefly.

12512. That is wetting the dust ?—Yes.

12513. What is your own plan of having the dust removed from the roads ?—Filling it out.

12514. By whom ?—By the night labourers and night repairers.

12515. What part do the hauliers play in it ?—Very little indeed on the engine-planes.

12516. Where does their part come in ?—On their own roads—in-bye.

12517. Not on the main roads at all ?—Not a single yard.

12518. Since when ?—It never has occurred at Mardy. The only man who fil's there is the man who rides there, the rider, and he fills dust occasionally, but as a rule he confines his attention to filling up any lumps of coal that he finds on the road, and he leaves the dirt work to the night repairers and night labourers.

12519. Then you do not know of the practice of cleaning the roads by the hauliers ?—No, I do not, except they clean in-bye, as I pointed out before, any headings or horse haulages, but not on our main mechanical roads.

12520. How often do you have the finest dust cleared out ?—With regard to clearing out the finest dust, I suppose it is difficult to do so until a fall occurs, that brings the fine dust down with it ; and when they are pulling a fall they pull the timbers out, and then the finest dust will come from there.

12521. And again that is the place that is likely to be restored ?—Yes.

12522. Have you ever tried the vacuum-cleaner system ?—I have not.

12523. You have had no experience whatever of it ?—I have had no experience of it. The only thing I know about it is that I heard the gentleman who was here yesterday, Mr. Hodges, I believe, give his experience of it.

12524. Seeing that the new tram is such an effective instrument for reducing the amount of small coal which is crushed into dust on the main roads, how long will you keep the old tram in vogue at Mardy ?—We are changing them daily.

12525. And you have known of this danger from 1887 ?—Do you mean the danger of coal dust ?

12526. Yes ?—Yes ; and we have been altering the trams ever since 1887, until the number of the old type of tram is getting less.

12527. So that it has taken you from 1887 till now, and still there are some of the old trams left ?—I am not

Digitized by Google

responsible from 1887 until the present day; my responsibility began three years ago.

12527A. (*Mr. F. L. Davis.*) You mean at that colliery?—At that colliery.

12528. (*Mr. Wm. Abraham.*) In your experience is there not a far greater danger where water percolates through the roof and sides than where it is simply used for damping purposes?—It is a question of degree altogether.

12529. Very well; then let us have the degree?—If the water percolates through the top for a length of time it will mean that you will have constant trouble there; you will have to timber that place as long as the colliery is open, and as long as you throw water on the top so it will continue to break down.

12530. But has it not been your whole experience at Mardy that the only danger which you have had to take deliberate precautions against from watering was the fact that water was percolating from one seam to another?—No, not at all.

12531. Have you had any danger from the effects of artificial watering?—Do you mean in watering a road?

12532. Yes?—We have.

12533. Where?—In several of the seams; in that the man has been careless in watering and has brought down a fall on the main engine-plane.

12534. In your opinion, stone arching is not possible?—Stone arching is possible, but it is not possible to be paved and lined and expected to keep in a smooth line so as to prevent any dust settling for any length of time.

12535. That is a qualification. I thought you said, some time ago, that arching was not practicable?—I do not think I gave that answer.

12536. Then arching is practicable?—Arching is practicable.

12537. (*Mr. F. L. Davis.*) If you always keep doing it; but you say it will not stand?—Yes, that was my point exactly. As for arching, we can arch, but it is not going to last for any length of time.

12538. (*Mr. Wm. Abraham.*) But is it not the practice in South Wales to arch the bottom of the pits?—It is.

12539. Is that not the most impracticable place as a rule?—No.

12540. Is there not more squeeze at the bottom of a pit than anywhere else?—Not if there is a good pit pillar.

12541. At Mardy, for instance, have you had to renew the arches under the pits often?—No.

12542. Do you know collieries in South Wales where they have a mile, a mile-and-a-half, or two miles of arches which have stood up for years?—I do not know of a single one which has stood up for years without continually rebuilding, the same as we do. We have lengths upon lengths of arching at Mardy—I might say hundreds and hundreds of yards, but it is constantly breaking down and has to be rebuilt.

12543. But you find no impracticability in doing that, do you?—Not at all.

12544. Then would there be any difficulty in making a zone of 100 yards in length with timber or with steel, with a smooth surface, so as to make a zone which could be kept practically clean; of course, you can never have it perfectly clean, but practically clean?—Do you mean a steel tube?

12545. No, I mean your props and crossbars made of steel or of iron?—Yes.

12546. So that it should be made into a smooth surface which could be easily kept clean. Have you given any attention to that at all?—Yes, we have several lengths of iron timbering, if one may use the term, but they are not smooth.

12547. You have not carried it so far as to have a smooth side or a smooth roof as yet?—Yes, we have it. Of course, they are horse-shoe type, and they have timber right round the horse-shoe.

12548. Then you find that easier to be kept clean than the other ordinary parts?—Of course; there is less settling place for the dust, certainly.

12549. Yes, exactly. Would not zones of that kind in particular parts of your various districts, kept clean, help to prevent the extension of an explosion from one district to another?—I have serious doubts of that.

12550. Then your plan now is to have watered zones—wet zones?—Watered zones, I believe, are preferable to dry zones.

12551. (*Mr. F. L. Davis.*) How did you make those experiments with the dust; were they made since you were at the colliery?—Yes, since I was at the colliery under Mr. Griffith Thomas's supervision.

12552. Now will you explain how they were made; were they made in a prepared chamber?—Not in a prepared chamber. We simply got the dust, some tubes, and some air passing through those tubes at various velocities and mixed it up with the dust and tried to fire it at one side of the tube, or the other side of the tube, as best we could, but we failed utterly to get any ignition whatever.

12553. I was wondering whether you had tried the experiments with different velocities of air mixed with the dust?—We have done so.

12554. You have tried it in every way that you could think of?—In every way that we could think of, and we failed; but it was not through an enclosed chamber.

12555. No, it was through a tube?—Yes.

12556. You have explained the gradual adoption in your collieries of the trams which are now used with three sides of them closed and one end open?—Yes.

12557. With the old kind of screen, many of which are in use still in Wales—I mean not the tipplers—is the reason that the bars are used instead of a door, we will say, because of the difficulty by reason of the doors coming in contact with the screen at the time of screening?—That is the reason.

12558. Some modification of the present arrangements would have to be made if you were to adapt doors to the trams?—It would be.

12559. Is it your experience that those closed trams are becoming generally used in South Wales?—I believe so.

12560. And have been used gradually for some time?—Yes, gradually coming.

12561. Not since this Commission was appointed, but for some years?—Yes.

(*Mr. Wm. Abraham.*) For three years.

(*Mr. F. L. Davis.*) Oh, more than that.

(*Witness.*) We have had completely sheeted trams since No. 3 pit was sunk; that was in 1895, and since then every tram that has come there has been sheeted.

12562. You remember a case where some of your screens were some little distance from the pit top?—Yes.

12563. How far off would they be?—About 25 yards; from the mouth of the pit, I suppose, you might say about 45 yards.

12564. Would that be your newest pit at Mardy?—No—No. 1 and No. 2 downcast.

12565. That is an alteration at the existing pits?—It is an alteration at the existing pits.

12566. May I ask you what was the reason of the alteration: was it because another pit had been sunk near, and you were screening the coal from the two pits together?—The screens had got very old, and they required renewing, and instead of replacing them close by, owing to the improvement of trade, and for the purpose of further improvement in the cleaning of the coal, we decided to move them further out.

12567. Simply as a matter of convenience?—Simply as a matter of convenience.

12568. Do you think there would be very great difficulty in many cases in South Wales in moving the screens?—There would be very great difficulty, because in some cases the screens now abut upon the main railway.

12569. Following out what Mr. Abraham has asked you, with regard to whether you knew if besoms were used in other collieries, putting it rather strongly to you; from your experience of other collieries which you have seen, do you think more care is taken and has been taken lately for some few years in cleaning the roads and keeping them free of dust than was formerly the case?—Yes, considerably; and more than that, I may say that the matter has been discussed at the Pontypridd Officials Association considerably as to the best means of dealing with this question. That was long before this Commission was even mooted.

12570. As I understand you, in speaking about arching your point was not that arching could not be done; it could be done in almost any seam, I presume?—Yes, in any seam.

12571. But your point, as I understood it, was that, whether for zones or not, the difficulty with regard to

Digitized by Google

Mr. T. E. Richards.

7 Feb. 1907.

the arching is that it will not stand for any length of time?—Exactly so. As to the question of paving, I do not know what would be the result of that; I do not think paving with us would stand more than a week.

12572. You would not start your experiments in a 4 ft. seam by paving, would you?—By no means.

12573. That is a seam where you are especially subject to heaving of the floor, are you not?—The floor in the 4 ft. is very much inclined to heave.

12574. (*Mr. Wm. Abraham.*) That is about the worst with regard to heaving, is it not?—We have one which comes a very close second, and that is one of the lowest seams in No. 1 Pit; that is quite as bad. I have given you the details—three times we have had to cut bottom in 18 months.

12575. Did they work the 4 ft. seam at Nixon's Navigation and Mountain Ash?—Yes, they have done it.

12576. That is the principal seam?—Yes.

12577. It has been worked for several years?—Yes.

12578. Have they miles of arches in those collieries now?—I have no knowledge of that.

12579. You do not know it?—No. I may say that the Aberdare 4 ft. seam is not the Rhondda 4 ft. seam.

12580. We are not investigating matters with regard to the Rhondda more particularly?—No.

12581. (*Mr. Enoch Edwards.*) I gather from your observations that you as Managers have taken counsel together in Wales on these questions?—We have.

12582. The question in the form in which Mr. Abraham put it to you would assume that you have discussed at considerable length, and often, this question of coal dust?—Exactly.

12583. I suppose I should be right in saying that since the terrible disaster in France you have met and reconsidered the whole position?—Yes; in fact I might say that the question is now under discussion, and the Report by Mr. Atkinson is on our Agenda.

12584. One of the matters you seem all to be agreed upon is that if you water a mine you would increase the number of accidents by falls of roof and sides?—If you water the roof and sides.

12585. If a mine is watered you increase the number of accidents?—I do not think I have given that evidence to-day. My point refers to the watering of roofs and sides—that that will bring it about; not the watering of the floor.

12586. Your reasons for that I understand are that you have some experience of mines which are damp or wet?—Yes.

12587. And the number of accidents in them?—Yes.

12588. Mines that are naturally wet may be more treacherous in regard to timbering, in regard to the roof?—I think we are at cross-purposes. I have not dealt with mines that are naturally wet.

12589. No; but you have mentioned some seams yourself which you have, that are wet, in which the water percolates through?—I beg your pardon; we have some seams in which water is unusual, but it is simply local. It is this unusual water which has caused us trouble in the steam coal measures. The steam coal measures are naturally dry, and when we have water it causes a good deal of breakage in the top.

12590. But is not the suggestion after all made in your own Notes here; you say that in the years 1904 and 1905 the deaths from explosions were 21 and 178 respectively, while the deaths from falls of roof and sides were 497 and 502. Those are the Tables for the whole of the United Kingdom?—Yes, for the whole of the United Kingdom.

12591. The number of explosions would be limited to one, two, or three?—That is so.

12592. The number of accidents would almost be about the number of deaths?—Exactly.

12593. So that it is possible that, if you get an explosion on the scale of that at Courrières, you would kill more people by one explosion than by 497 single accidents?—That is perfectly true.

12594. One of the objects of watering, either general watering or zone watering, is to prevent the destruction of human life where an explosion does occur?—It is.

12595. Against that the tenor of the position which you are taking up here is that watering will injure, or might injure, your mine, however you do it?—The watering of roofs and sides.

12596. Still you agree that watering by zones would minimise that loss, and you think that is practicable in most mines?—It is practicable; I believe that. Of course there are exceptions in which you would not be able to do it.

12597. There are always exceptions in mines; whatever phase of the question you touch there are exceptions?—Quite so.

12598. In some collieries, to my knowledge, it has cost them 6d. per ton and more—9d. per ton—to pump water out. That would be quite an exception, would it not? In dealing with the question of shot-firing, I think you will agree that most of these accidents arise from shot-firing more or less?—Yes.

12599. With regard to shot-firing on the main haulage road, I understood you to suggest that in some of these engine-planes they are timbered up above your timbers?—Yes.

12600. What you mean by that, I suppose, is that there have been large falls there?—Yes.

12601. And that those falls may not only conceal dust, but gas also?—If we fill it up as best we can, there would be less cavity for gas and dust. We fill it up as much as possible.

12602. You have no means of getting up to look at it afterwards?—No.

12603. In firing shots in those main haulage roads are they always fired in the top?—Generally in the top.

12604. It would not be necessary to fire a shot in the top in a road which has falls, would it?—No; but you might have, say, 100 or 150 yards of bad top, and you might have very good top for the next 150 yards which you would want to shoot down, and the other part would have to be heavily timbered.

12605. Assuming that in an engine-plane you had had considerable falls and packing of timber—very big falls—but that a few yards from the fall you had some hard stubborn rock, or other material which you wanted to blast down, how would you proceed to blast there without exploring the place above?—We should explore it.

12606. And if you could not get up to satisfy yourself, what then?—We should water it thoroughly all round.

12607. Of course, the watering would only apply to the dust?—Exactly, but we should have it examined as far as we could possibly get up.

12608. Those conditions of a roadway were not in your mind when you were asked the question as to the safest place in the pit. You said the safest place now in your colliery was the face. Why do you say "now"?—The safest place I should say with freedom from this fine dust which is so explosive.

12609. But I am suggesting to you that considerable dangers lie in these roads if you are going to blast. Was this at all in your mind when you said that the face was the safest place now?—Yes, exactly, because of the presence of coal dust on the main haulage roads. It would be more explosive there in putting in a shot than it would be anywhere in the face.

12610. Why is it so now more than it was before?—Because the ventilation is so much increased.

12611. That is your explanation?—That is my explanation; the greater the velocity of the air current the finer the dust.

12612. I will not labour this question further, but I gather that you are not disinclined to take the view that there should be watered zones?—I believe that of the two those are the best.

12613. I suppose you would agree that for the general well-being of a mine it is better that dust should be cleared out even if you do not water it?—It is.

12614. (*Mr. Smillie.*) I suppose I may take it that the deeper mines are, because of increased temperature, there is likely to be more dust of a dangerous description; I mean if the nature of the seam was the same?—Exactly. From experience in Belgium I did not find so much dust, but that may be because the ventilation was not so strong.

12615. The atmosphere in a shallow mine is likely to be more moist than it is in a deep mine?—It is so.

12616. And, naturally, there would not be so much dust as in other mines?—Exactly.

12617. I suppose when you say that arching is almost

Digitized by Google

impossible in very deep mines you are thinking of a certain system of working. Are you thinking of the longwall system ?—Yes, the longwall system.

12618. In all your examination to-day you have been dealing with the longwall system ?—Yes, the Welsh system.

12619. Is the longwall system universal in Wales ?—I believe it is practically universal. It is the system in nine collieries out of ten.

12620. Which means that all over the whole seam when the coal is taken out, there is natural creep with weight from the top pressing it down ?—That is so.

12621. I suppose you have known in your experience large barriers of coal being left in under railways and under waterways ?—Yes.

12622. Barriers which sometimes may be 200 yards or 300 yards long ?—Yes.

12623. You have pointed out to Mr. Abraham that the bottom of a pit was not the most dangerous place for crush, because of the fact that you leave coal pillars in the bottom ?—That is so.

12624. I think in all collieries there are large pillars left close to the bottom, and they are left larger according to the depth ?—Yes.

12625. The deeper you go the larger you leave your pillars ?—The deeper you go the larger you leave your pillars.

12626. That is to keep your bottom from crushing ?—Yes.

12627. Unless you did leave larger pillars the bottom could not stand ?—That is so.

12628. In opening up deep collieries where arching would be difficult, would it be possible to leave at certain distances along what was going to be the main haulage road, a coal barrier of 50 or 60 yards wide on each side, and perhaps 100 or 200 yards long ?—From my experience I found that is about the very worst thing you could do in the South Wales coalfield. Either you have to work the whole way or you have to leave a large piece standing, and your headings must go through in the solid; any half measures would mean an extraordinary increase in the cost of your timbering: the top breaks up alongside the pillar and you have to pay for it severely.

12629. But supposing you are going underneath a railway, where there was a danger of the railway being injured, would you not have to leave barriers of that kind ?—Then you would have to leave your barrier in such a way that your headings would go through it, and you would have solid coal on each side of you.

12630. That is what I suggest, that you could leave solid coal on each side of you for a certain distance, and that that would form a zone which you could arch with safety ?—Well, that would be reducing the pressure upon the arches.

12631. Certainly; if it holds up your pit bottom it would also hold them up there ?—It would.

12632. And you could have zones made in that way which could be arched. I take it you have 1,600 yards of main haulage roads which are watered ?—Yes.

12633. Thoroughly watered ?—Thoroughly watered.

12634. Do you water the sides and roofs ?—No.

12635. You do not touch them ?—But very little.

12636. Do you consider that that is thorough watering in the sense that we are enquiring into now ?—It is. I understand the watering you require is that which shall be sufficient to prevent a large amount of dust accumulating, and I believe that is a means whereby it is prevented from accumulating—in the way we do it—without doing any greater harm.

12637. Our opinion is that coal dust may not initiate an explosion, although it is possible that it might do so with a blown-out shot, but that it at least carries it on when it is initiated ?—That is so.

12638. Do you not think that in a wet zone or in a part of your mine where you have watered the pavement or floor there might be sufficient dust on the timbers and sides to continue an explosion ?—From the Reports of the Inspectors we have several cases of recent explosions in which a naturally damp swampy ground with no water percolating through the roof, but simply some water coming there, has been the means of stopping an explosion. My opinion is that the presence of that zone has a tendency to dampen the air and to prevent accumulation of dust.

12639. But if there was fine dust on the timbers it would carry on and continue the explosion ?—That is so.

12640. I think you put the cost ultimately for thorough watering of all parts of the mine, at about 6d. per ton increase ?—Yes.

12641. And you have 16,000 yards now of your main haulage roads in water—the whole floor ?—Yes.

12642. Supposing that, instead of having the whole 16,000 yards continuously watered, you had 10 zones of 100 yards each, that would come to 1,000 yards as against your present 16,000 yards ?—Exactly.

12643. Would that reduce the cost of watering there in the proportion of 10,000 to 16,000 ?—I think I ought to put you in possession of what these 15,000 odd yards mean: I think we have about 19 or 20 different engine planes.

12644. Those are practically zones ?—Those are practically separate zones, and those 15,000 yards ramify over the whole.

12645. Just so: it is not 15,000 yards of continuous roadway ?—No; they are three pits with roads branching off from the main pit parting in each case.

12646. Your experience is that the greater explosions we have had in this country have been initiated in the main roadways. That is the experience of past explosions, that they have been initiated in the main roadways ?—Most of them have.

12647. The more serious ones ?—Yes.

12648. Do you remember the explosion at the MacLaren Colliery, at Abertwssyg ?—Yes.

12649. That, I think, initiated at the coal face ?—It was initiated at the coal face.

12650. And it was a gas explosion, to begin with ?—So it is said.

12651. I think there is no doubt that, although dust played an important part ultimately in it, it was a gas explosion to begin with ?—Yes, it was initiated by a slight accumulation of gas, so I am informed.

12652. Do you know whether or not the MacLaren Colliery had been watered in any part of it ?—I cannot say. I know nothing about the colliery.

12653. Do you know how that explosion travelled; was it the main haulage roads that it traversed ?—I cannot say; I do not know.

Mr. George Stephenson Bragge, called and examined.

Statement of Witness:—

12653a. (1.) I do not think we have sufficient evidence on the question of dust generally to be able to dogmatise on the matter. A long series of practical experiments, analyses, &c., are necessary before we have the necessary information on the subject.

Classification of mines would be difficult. Most mines are more or less dusty. There would be very few in the actual non-dusty class.

(2.) Evidence of such explosions as Timsbury, and in flour mills and maltings, appear to show that most fine dusts are explosive under *certain* conditions; but we do not know what those conditions are. Dust in the South Midland district appears to be of a low explosive nature, as no large explosion has occurred in the district.

I do not think a naked light alone would cause an explosion of dust. Naked lights are freely used about screens, hoppers, &c., where there are large quantities of dust and no explosion occurs. In my opinion (though I do not claim to be an expert on explosions), the cause must be looked for in connection with detonation or

Digitized by Google

Mr. G. S. Bragge.

7 Feb. 1907.

vibration. Probably there is some connection between the pitch, or timbre, of the detonation and the liability to explosion, *e.g.*, articles in a room "singing" to a piano or other instrument, and reported cases of singers breaking glass by singing.

The "safety explosives" are examples of similar conditions; they require firing with a detonator of a certain strength before they develop explosive character.

(3) Dust is on haulage roads chiefly. Face dust is too coarse. Fine dust is also to be found on timbers in return airways where there is no mechanical haulage and the floor not disturbed by men travelling.

(4) (*a*) The source in the latter case is probably the finest dust blown from the face.

(*b*) In the South Midlands only "riddled" coal is sent out of pit: any escaping from tubs must be ground very fine to become dangerous.

(*c*) The quantity of dust blown off tubs in the Midlands is insignificant. Nearly all our haulages are slow motion—2 to 2½ miles an hour. In one case of main and tail haulage (8 to 10 miles an hour) against the air current, the road was not found to be more dusty than in case of slow motion haulage.

(*d*) From the surface and shaft, *i.e.*, the full tubs going up against the descending air. Screens are certainly large dust producers, but I have made a simple experiment showing that dust is carried along roads near pit bottom even when screens and cages are standing.

Dust begins very near pit bottom and more is deposited (in my colliery) on out-bye side of bars than on in-bye side.

Q. Has smoke from surface any effect?—My district is smoky, and a considerable amount of carbon is in the air a mile from the works.

31 The principal sources of dust are from the surface and shaft, and what is dropped from tubs.

(5) As to (*b*) the tubs in the Midlands are generally very good, and could not be much improved. Covering them is impossible, as they are loaded much above the level of the sides. Spraying some coals would be most detrimental to their value. Many of our seams will not stand stacking at all.

As to (*d*) removing screens or collecting dust, the witness has no experience of this. I should object to moving my screens unless I was absolutely sure they were the chief source of dust. Have any trials been made proving this to be the case?—In my case, the screens are 30 yards away from shaft and under a separate roof from the pithead covering.

(6) I consider complete watering impossible for many reasons. Firstly, it is almost impracticable over long roads. Secondly, many floors will not stand it. I have had practical experience of this in a road several hundreds of yards long which was naturally wet, with a fireclay floor, and great expense had to be gone to to drain the road.

For the Midlands the present rules as to watering before shot-firing are sufficient.

If watering must be done, zones are sufficient.

(i) I do not advocate complete watering, and have had no experience of other systems, not considering them necessary in non-fiery mines. Some roofs and sides would be absolutely destroyed by watering—(Kilburn seam). Process would have to be carried to saturation to destroy all dust. To do this would require watering, say, every 24 hours.

(ii) I believe, in my own case, that a system of removal of dust *plus* watering, as is now carried out for comfort, could be made effectual. This would be sufficient for moderately dusty mines. I have had no practical experience in very dusty mines, nor do I know what length of watered road would stop an explosion.

I have no figures as to the cost of watering.

As to danger, I have hundreds of yards of roads which I am sure could not be kept open if thoroughly watered. Danger of falls would be enormously increased. Moist heat would probably be more dangerous to health than dry and dusty heat (I have to do with some fireclay mines which are wet and non-dusty). and the men look very "pasty" compared with colliers.

(7) The removal of dust *plus* watering should be confined to zones. Elasticity as to the position of the zones should be permitted, so that the least detrimental places can be chosen, *e.g.*, a stone-head through a fault, where watering would least damage the floor and sides.

(*a*) If the floor will stand watering without heaving, paving is unnecessary. If water causes heaving of the floor, the only way to deal with it would be to put in a barrel arch, or arch with inverted bottom. This is very expensive work.

As to mortar for sides, in many (probably most) of the longwall pits of the Midlands, so much mortar would be required to fill up the packs, that it would probably be cheaper to take out the packs and put in brick walls. But why do all this when we do not know that it is effective, and on the off-chance of an explosion that may never occur?

(*b*) I have no experience of the use of salt, except that when used on tramways it makes it impossible to keep the feet dry when once the boots have been wet with it.

(*c*) As to the suggested use of non-inflammable dust, this would have to be used frequently to have any effect on the inflammable dust.

(8) *Westphalian Mines.*—I am not acquainted with their present conditions. (*Q.* Probably the same regulations as to watering are in force at Saarbrucken, where there was a recent explosion?) At any rate we have not the "worm disease."

12654. You are a colliery manager, and you are now manager of the Granville Colliery, Swadlincote, Burton-on-Trent?—That is so.

12655. You have been past president of the National Association of Colliery Managers?—Yes.

12656. Have you had any experience of collieries in other parts of the world besides Burton-on-Trent?—Not very much, and I should like to confine my remarks chiefly to that neighbourhood.

12657. Where have you been besides?—I have been in the Derbyshire district in the neighbourhood of Ilkeston, only for a short time.

12658. Nearly the whole of your experience is at Burton-on-Trent?—Yes.

12659. You begin your synopsis by saying that on the question of dust generally we have no sufficient evidence to dogmatise on the matter, and you suggest that a long series of practical experiments, analyses, &c., are necessary. What sort of experiments would you suggest?—I would suggest something in this way; in firing into a mixture of air and explosive dust, I do not think we yet know quite enough about the point which I refer to a little later on as to the conditions under which explosions take place; I mean in the way of firing larger or smaller quantities of explosive matter, and larger or smaller shot holes, and different quantities and qualities of dust. I think there may be something in that which at present we do not know quite enough about.

12660. You think that a good many experiments ought to be made with regard to shot-firing with dust of various kinds?—I think so.

12661. You talk about analyses. Do you suggest that the coal dust should be analysed and its explosive qualities tested in some way?—I think so. I do not know whether the Commission has been overdone with samples, but I have taken one or two.

12662. We shall be glad to see them.—It seems to me, as a non-scientific man, not as a chemist, that in dusts which might be expected to have the same character, there seems a difference. I have collected some of what I consider the worst quality of dust from the top of the bars, and there certainly is in the same colliery a slight difference in appearance in those dusts.

12663. You do not know whether they have the same explosive qualities or not. There is a difference between the dust taken from the roof—— ?—And from the floor; it is very marked indeed.

12664. The difference between the dust on the floor and on the roof is very marked indeed?—It is as regards fineness and size, and it appears to me as regards weight. I have not had time to weigh equal quantities. I should say the dust from the floor is very nearly double the weight of that taken from the top of the bars.

12665. Even if you take the finest dust from the floor?—I have tried to take the finest dust from the floor, but it is very much coarser than what you get from the bars.

12666. Could that not be the reason of it being heavier?—That might be so.

Digitized by Google

12667. You say there is a difference in the constituents, independently of one being finer than the other. They look different ?—They look rather different; in fact, the dust from the bars looks almost like soot; the dust from the floor looks like dust.

12668. It is greyer ?—Yes. I have some here.

12669. You have specimens which you can hand round ?—Yes.

12670. You think there ought to be first of all experiments with regard to shot-firing as to the size of the holes and as to the amount of the explosives used ?—As to the amount of the explosive used.

12671. And as to the size of the hole ?—I think with regard to the size of the hole, if my theory has any value it might throw some light upon the matter.

12672. How do you mean, your theory ?—That certain detonations are more dangerous than others.

12673. Perhaps the detonation from a small hole might be more dangerous than the detonation from a larger hole, or the detonation from a large hole might be more dangerous than the detonation from a smaller hole ?—Yes.

12674. Or perhaps from a different shape of hole ?—Yes.

12675. You go on to the classification of mines and say that there are very few mines in the non-dusty class. You class almost all mines as dusty ?—More or less.

12676. If they are dry ?—If they are dry.

12677. They are certain to be dusty if dry ?—Yes, more or less.

12678. In Paragraph 2 you say that evidence of such explosions as Timsbury and in flour mills and maltings appear to show that most fine dusts are explosive under certain conditions, but we do not know what those conditions are. With regard to the coal dust you would try and nd out the condition by analysing the coal dust and finding out what sort of coal dust is most inflammable ?—I think that has something to do with it.

12679. You say i the South Midland district the dust appears to be of a low explosive nature as no large explosion has occurred in the district. To what do you put that down—the low explosive nature of the dust in the South Midland district ?—I am not prepared to say. I go on facts.

12680. But the fact that there has been no large explosion seems to show that the dust is of a less explosive character than any other place where there have been large explosions ?—Yes.

12681. It might be that the explosion was iust as bad in the Midlands, but that the dust does not carry so much ?—It does not carry the explosion to the same extent.

12682. Do you have very large underground inter-communication in the South Midland district ? Supposing the dust was to carry an explosion, there would be many seams where the explosion would traverse where a great number of people were working ?—Our collieries are not on a very large scale.

12683. Therefore, you could not have an accident like Courrières because there is not sufficient inter-communication underground ?—That is so.

12684. That might be taken into consideration when c mparing the South Midland district as regards liability for large explosions with other districts; the non-liability might be caused partly by not having such a large underground inter-communication ?—I do not mean to say we have never had an explosion of gas in the South Midland district, because we have had one or two small ones, but they have been confined to very small areas.

12685. What has confined them to that area—there simply being no underground inter-communication or that they have been stopped ?—That they have simply not spread.

12686. Even though they might have spread. There is no apparent reason why they should not spread ?—I can think of one instance where, if the dust is so dangerous it might have spread. The explosion was on a main road.

12687. It did not spread ?—No, it was only a small one.

12688. Was the main road watered ?—Not to any great extent.

12689. It was a fairly dry main road ?—Yes.

12690. There would be a certain amount of water on the floor ?—Not visible water.

12691. Would it be damp on the floor ?—No, it would be dry, what we would call dry.

12692. Would this haulage road be very free from dust ?—I think not.

12693. And yet the explosion did not travel ?—There was a certain amount of dust, and yet the explosion did not travel.

12694. You do not think that a naked light alone would cause an explosion of dust, that is to say, under circumstances which would be likely to obtain underground ? It has been shown that a naked light can cause an explosion in a hopper. It has been alluded to here. You think there is some connection with the pitch or timbre of the detonation and the liability of explosion. Have you gone into that matter ?—No, I have not gone into it. I think that there must be something in it in the same way as I mentioned in the explosion of safety explosives—unless they are fired with a detonator of a certain force they are not of an explosive character. That has led me to think that in these coal-dust explosions caused by shot-firing probably there is something of the same kind. I may mention in connection with that in our district we are subject to spontaneous combustion. There we get a very slow disintegration of the coal dust, and it struck me that it is possible that there is in detonation some quick disintegration of the coal dust which may alter its character from what we see lying inert. I suggest that there may be something in that. I am not scientific enough to argue it all out.

12695. Now coming to Paragraph 3, you say that the dust is chiefly on the haulage roads; face dust is too coarse. Therefore you think that there is very little danger of dust explosions in the face ?—That is so.

12696-7. This dust is to be found on timbers in the return air-ways. The source of dust in the latter case, that is in the return air-ways, is probably the finest blown from the face. That would be the most dangerous. The further you get into the return air-way the finer the dust would be ?—I do not think I have observed anything of that sort.

12698. All the dust deposited immediately begins to be very fine ?—As far as I have observed it in the return air-ways, the dust there is fine.

12699. You have not noticed that it occurs any finer any distance from the face ?—No.

12700. You say in the South Midlands only riddled coal is sent out of the pit; any escaping from tubs must be ground very fine to become dangerous. Therefore you would say apparently that there is not a great deal of dust deposited from the tubs in your district ?—Not as dust.

12701. There is very little dangerous dust, at all events, deposited from the tubs. That is your experience ?—That is my experience. There is a certain amount of grinding of the coal which takes place on the haulage roads.

12702. On the haulage roads you would find from the tubs a certain amount of very fine coal dust ?—Yes.

12703. Consequently, you would say that the tubs, as you go on to say, ought to be of a dust-tight character as far as possible. That is one thing you suggest, I suppose. You say the tubs in the Midlands are generally very good, and could not be improved ?—That is so. I see no way of improving them except by substituting solid tubs, such as iron tubs.

12704. Solid iron tubs. Supposing you had them solid three sides, with a door in the fourth side, how would that do ?—It would not suit our district at all.

12705. You must have them solid on all four sides ?—We have them solid now, but the coal is loaded much above the sides.

12706. You say the cover is impossible. As to spraying, it would injure the character of the coal ?—It would.

12707. Therefore you do not think that it is practicable. The only way to avoid dust being thrown out during the haulage would be to have dust-tight tubs. Then as regards removing screens or collecting dust, you have had no experience ?—Not as to collecting.

12708. You object to removing your screens unless assured that they are the chief source of dust, and your screens are 30 yards away from the shaft and under a separate roof from the pit-head covering. You consider that is sufficient. You think 30 yards away from the shaft and under a separate roof is a sufficient proportion to take as regards the screens ?—That is so.

12709. To prevent the dust going down the shaft.

Digitized by Google

Mr. G. S. Bragge.

7 Feb. 1907.

You say you have had no experience in collecting dust at the screens ?—There is nothing done beyond the ordinary cleaning up which we do every day on the screens ; it is swept up and left ready for the next day's work.

12710. The screens being 30 yards away from the shaft, it does not matter for the dust below whether you collect the dust or not ?—I have looked at the matter as regards our own colliery since this question came before me, and I do not think that it makes a great deal of difference in our case.

12711. You consider that watering is impossible, and is almost impracticable over long roads, and that many floors will not stand it. What sort of proportion of the roads could be watered, do you think, without great deterioration setting in ?—There are some seams in which you could not water any portion of the road without very seriously injuring the road.

12712. What do you do with those seams ?—In those seams we simply, as I say, clean up a certain amount of the dust, but we do not collect the whole of the dust in the South Midlands. We have never found it necessary.

12713. You collect as much dust as you think desirable to remove ?—For comfort.

12714. Has it anything to do with danger ?—No. I think we may say that we have not considered the dust in the South Midlands a source of great danger.

12715. A source of any danger ?—Ours are not fiery mines.

12716. You think the dust is not dangerous ?—That is my idea.

12717. You have had explosions ?—Small ones.

12718. Which do not spread ?—No.

12719. Still you have had explosions, and I suppose explosions of coal dust, or have they been always coal dust mixed with gas ?—Always, as far as we know, gas explosions pure and simple.

12720. You do not know any explosion of coal dust alone caused by a shot or anything else ?—Not one.

12721. You say if watering must be done that zones are sufficient. What do you suggest as the length of zone as sufficient ? You have very little experience ?—I must say I have not had experience of that.

12722. As regards dealing with dangers from dust you have nothing to suggest. You consider that the coal dust is not dangerous in your mines ?—I should suggest that if it is found that coal dust is dangerous that zones are all that are necessary, and, as I suggest, some elasticity might be allowed in the position of these zones, because I admit that in some of these seams with bad roofs there might possibly be places found, such as stone drifts through a fault, where it might be possible to water without damaging the roads.

12723. With regard to the mines you have a knowledge of, you do not think from the point of view of safety that any more watering is required than that which takes place. The only artificial watering would be when shots are fired ; or do you have any other ?—No, we water the roads with water that comes down the shaft. It is collected generally in barrels, and is taken along the road and thrown along the floor, let out of the barrels while the barrel is travelling, and it spreads over the floor and waters the road to a certain extent.

12724. The only system you adopt is casual watering from barrels ?—Yes.

12725. You have no systematic watering ?—No ; we have no systematic watering with a view to preventing dust.

12726. What do you want watering for ?—For comfort, to a great extent. It prevents an undue accumulation of dust.

12727. Just the amount of watering that tips over naturally from the barrels as they move along the haulage roads is quite sufficient for comfort ?—Yes. A plug is removed from the bottom of the barrel, and the water escapes on to the floor as the barrel passes along the road.

12728. As to safety you have nothing to say, because you think you are quite safe ?—That is so. We have not had systematic watering in our mines with a view to safety from dust explosions.

12729. Where there is danger you consider that you should have both watering and removal of dust in zones ?—That seems to me the simplest way of dealing with it, taking my own experience.

12730. You say if the water causes heaving of floor the only way to deal with it would be to put in a short arch ?—A barrel arch, or inverted.

12731. It would be very expensive, and in your colliery would this arch stand or be crushed in ?—We should have to put it in strongly, and then it would stand.

12732. How long would it last ?—For many years, if put in strongly. I have had experience in doing that. It is a very expensive thing to do.

12733. That is the only way which you can suggest of making a roadway which would be efficiently watered and swept. If that is not done the roadway could not be efficiently watered and swept ?—The ordinary roadway could not be watered and swept ; but, as I suggest, there may be places in collieries, and probably are places in different collieries, where the roadway has been carried perhaps through the solid stone, where an archway would not be necessary.

12734. Then, as to mortar for sides, you think so much mortar would be required to fill up the packs that it would probably be cheaper to take out the packs and put in brick walls. You do not suggest that it should be done because you do not know that it would be effective, and that an explosion might never occur. Your evidence is that really the question of danger does not practically arise. At all events, wherever you have an explosion it is an explosion of gas, which probably could not be prevented in any way. How would that explosion of gas take place —from a man using a naked light or taking down matches ? —Using naked lights it was in that case.

12735. You do use naked lights ?—On the main roads, and in many pits in the faces as well.

12736. Although explosions sometimes occur ?—Yes.

12737. Do you think it right that you should use naked lights under those circumstances ?—I do not say in every pit.

12738. You have had small explosions from time to time which have been caused in every case by naked lights ?—The two I am thinking of were caused by naked lights.

12739. Which ought not to have gone down ?—They were both some time ago, and in both cases safety lamps were substituted.

12740. Do you have any naked lights now ?—There are certain seams worked entirely with naked lights.

12741. How long is it since you have had an explosion due to a naked light in your colliery ?—In my colliery I cannot tell you how long—many years.

12742. Have you had any other explosion due to anything else during the last few years ?—No.

12743. It is a long time since you had any explosion at all ?—That is so.

12744. How long ago were these two explosions you talk about ?—One of them 10 or 12 years ago, and the other 22 or 23 years ago.

12745. For 10 or 12 years you have had no explosion ?—Not at my colliery. I have had a slight explosion, not causing any injury, in one of the pits which I was working with naked lights, and immediately upon that I put in safety lamps.

12746. What district is it where these two explosions took place ?—They were not in my mine, but they were in the district with which I am principally acquainted.

12747. So that you knew the circumstances of them ?—I knew the circumstances of them.

12748. Do I understand that in these mines as well as in your mines naked lights are still used, or not ?—In my mines I work two seams with naked lights only.

12749. Do you think that is right ?—Yes : I have never had the slightest suspicion of there being any gas present whatever.

12750. Although yours are dry and dusty mines they are not dangerous mines, you consider ?—Not as regards explosions, I consider.

12751. Then about salt. You object to salt because it would be impossible to keep the feet dry ?—I simply mention that as the only matter that occurs to me in connection with it. I do not lay any stress upon it.

12752. Then if it was thought desirable to render inflammable dust uninflammable by mixing it with other dust, that would have to be done pretty often or it would

Digitized by Google

be no use ?—I take it so, if the dust were not removed previous to the sprinkling of the non-inflammable material.

12753. With regard to the Westphalian mines you do not know anything about them. Do you know anything about ankylostomiasis ?—I am afraid I do. Our colliery was the one suspected case in England lately. I came up to London and saw Mr. Cunynghame about it.

12754. You say at any rate we have not worm disease ?—Yes ; I take it from what I have read on the matter that the spread of ankylostomiasis is largely due to excessive watering in the German mines.

12755. But now you say you have had ankylostomiasis ? —No, one suspected case, and it proved not to be.

12756. (*Mr. Cunynghame.*) Your idea is that if you search in the roadway of a dusty mine the most inflammable dust would be found up high on the timbers above ?—I think so, from what I have observed from these specimens.

12757-8. Are you able to answer this question ? Would that be from the fact that when you take a quantity of coal and grind it up you would not find the particles into which it would be reduced all the same ; some would be of a different character from others. Do you follow what I mean ?—Yes.

12759. So much clay, for instance, for all I know, in a fine division, and so much other stuff ?—Yes.

12760. Your theory is the lighter particles go up to the top leaving the heavier and less inflammable particles down below ?—That is so.

12761. You have never tried any experiments to throw light upon that ?—No, I have not made any experiments upon that point.

12762. It is a supposition on your part, and not more, at present ?—No, it is a fact that the finer dust——

12763. We are not speaking of the finer dust. The question is whether, in addition to being finer, the dust above is of a different chemical quality from the dust on the floor ?—No, I cannot speak as to that.

12764. You spoke of mixing some unimflammable material with dust so as to render it non-explosive. Did you not answer the Chairman something about that ?

(*Chairman.*) There was a question asked about that. He said this would require frequent renewals.

12765. (*Mr. Cunynghame.*) I want to know what non-inflammable material do you suggest for mixing with the dust ?—It is not my suggestion, but if it were I should say that probably as far as I know small fireclay would be as useful as anything, or possibly even flue dust from the boilers.

12766. How are you going to get it to mix with the others ?—I do not understand the process of doing that. I did not speak as to that. That is a suggestion which was given to me, sprinkling non-inflammable dust or material. I did not suggest that.

(*Mr. F. L. Davis.*) That was Professor Galloway's suggestion.

(*Mr. Cunynghame.*) A question was asked, and I thought the witness knew something about it.

12767. (*Mr. Ratcliffe Ellis.*) You quite agree that there is a good deal to be learned about this subject ?—I do.

12768. And that it is very desirable that some experiments should be carried out in order to give further information upon the subject ?—I do think so.

12769. In your colliery what is the deepest seam ?—Our deepest seam is 450 yards deep.

12770. What is the thickness of the seam ?—4 ft. 6 in.

12771. Have you ever tried building any arches—a barrel arch or any other sort of arch ?—No. The seam I refer to is only about 300 yards deep in which we put an arch.

12772. If you take a seam of 450 yards, your deepest seam, do you think you could keep an arch up there ?—It would have to be an enormously strong arch.

12773. If you take double that depth, 700 or 800 yards deep, would it be possible to maintain an arch?—I think it would be almost impossible to build an arch strong enough to stand that pressure.

12774. You leave round about the bottom of your shafts a pillar of coal in order to support the shafts ?—Yes.

12775. That is the last coal you would get in connection with your colliery if you did not want the shafts supported. Is it practicable with you to leave pillars of coal alongside protected zones in order to support an arch built there ? Is it a practicable way of dealing with it ?—One would have to protect the arch by leaving large pillars of coal.

12776. You have zones to make in all your main haulage roads assuming this theory is carried out. How could you work your colliery and leave these enormous pillars in the roads at various points to support the arch ?—It would be a most serious hindrance to the working of the colliery.

12777. What do you suppose the lessor would say about it ?—He would probably make you pay straight-away.

12778. Your leases do not contemplate that you should leave, unpaid for, great areas of coal to protect arches ?—No, there is no provision in any lease that I know of.

12779. In addition to depriving the colliery proprietor of the benefit of a great deal of coal that he would otherwise get, and consequently increasing the cost of every ton of coal he does get, the lessor would be deprived of a very large amount of money in consequence of this coal being left ungot ?—That is so.

12780. Is this clearing of the dust from your roads done at all methodically ?—No. If the road is getting clogged up with dust we have that length of road cleaned up.

12781. What is the condition when it is clogged up with dust : is it that you cannot get your trams along ?—It is more difficult. It interferes with the working of the trams.

12782. It is not done with the intention of preventing any danger from explosion, but in order to facilitate passing along the roads ?—I must say in our case that is usually so.

12783. How often have you to do that to keep the roads clear for the traffic ?—About two or three weeks, taking one length of road with another. We say that if we clear up that, in about three weeks we think it will want cleaning up again.

12784. Do you brush the roof and the sides, or simply take it off the floor ?—Simply take it off the floor in our case.

12785. In your seams you never have it taken off the floor and roof ?—We have not taken it off the roof and sides.

12786. What is the condition now ? Is it covered with dust or pretty free from dust ?—No, it is rather dusty, I should say, on the top of the timbers.

12787. All that you do is to clear the floor ?—Yes, chiefly.

12788. Do you do any watering now ?—Yes.

12789. On the roads ?—On the roads about the same way as we do the cleaning up. We reckoned that about every three weeks the roads get watered.

12790. Your mine is not naturally wet throughout ?—No.

12791. It is dry as well as dusty ?—It is dry and dusty. We have water in certain places, and when that water is taken out, instead of being taken up the shaft, we put it on the roads.

12792. Although you water the floor you find the dust still on the roof and sides ?—That is so.

12793. Have you noticed that where a road is naturally wet, and not artificially watered, that there is dust on the roof and sides ?—I cannot recollect a case of having it except one that I mentioned, where we had a road naturally wet in the floor, and that was rather a new road, newly made, and I think there would be no dust upon it ; but that was because it was a new road.

12794. Where does the dust come from ? Does it come at all from the face ?—I do not think in our case the dust comes from the face, because we have dust on our haulage roads, which are intake roads.

12795. Some of it comes down the pit ?—Yes, undoubtedly in the atmosphere, not visible : but it does come down.

12796. Do you think that is a large quantity ?—No.

12797. Where does the great quantity of the dust in your mine come from ?—I am inclined to think in our mine the greatest quantity comes from the grinding of the coal on the roads, the small pieces that fall off the tubs and are ground up by the tubs as they travel along the road. I think a certain amount does come down the pit,

Digitized by Google

Mr. G. S. Bragge.

7 Feb. 1907.

because I find that we have a certain amount of dust near the pit bottom.

12798. I rather gathered from you that every three weeks you have to clear the dust away to get your trams along the road. Do you think a quantity of dust comes from the grinding of this coal very largely?—A good deal.

12799. In shot-firing do you fire your shots during the time the men are at work?—In the face?

12800. Yes?—Yes.

12801. What do you consider is the great danger attendant upon shot-firing. What has to be guarded against?—In the face?

12802. Take in the face first?—In our district I should say there might possibly be a slight amount of gas present.

12803. I am speaking of the shot itself. Is there anything in the preparation of the shot which ought to be carefully considered in order to prevent any danger from it?—I see what you mean. That is in the stemming. Yes, that is the most important point.

12804. The only question about drilling a shot is the size of the hole?—Yes.

12805. It might be necessary to stipulate that it should be a particular size under certain conditions. Having got your hole, stemming is important?—Most important.

12806. Supposing this stemming is defective, what is the result?—A blown out shot.

12807. It does not do its work. That is a danger?—Yes.

12808. Do you think that there is sufficient provision in the present law, in the General Rules and in the Explosives Order, to secure, if it is carried out, that the stemming is properly done?—I think so. I would certainly say in my own case that is a very particular point about shot-firing.

12809. How are you particular?—In having every shot in our pit fired by an official properly authorised shot-firer.

12810. Does he charge the shot?—No.

12811. Who does that?—The collier charges the shot but the official has orders and he carries them out as to firing the shot. If he considers that the shot is not sufficiently stemmed, or as we call it, put over the fast, he is not to fire it.

12812. Have you ever had any blown out shots, or is it a very exceptional thing with you?—It is a most exceptional thing with us. In several years' returns that we have made to Government I have had one blown out shot.

12813. How many shots do you fire in the course of the year? We are dealing with the face now?—Thousands.

12814. Many thousands?—Many thousands.

12815. Do you fire electrically?—Yes.

12816. (*Mr. Cunynghame.*) What explosive do you use?—We use bobbinite. I have used other high explosives.

12817. (*Mr. Ratcliffe Ellis.*) You think that bobbinite gets more big coal?—I do, I swear by bobbinite. I also consider it better for the roof.

12818. The stemming is the matter that you have to be very careful about?—I consider that is the most important point about it.

12819. Do you think that the provisions that exist at the present time are sufficient with reference to stemming?—I think so.

12820. You think that they require no alteration whatever?—I think they are quite right.

12821. With reference to shots in the haulage road, what is your arrangement about that?—With reference to shots in the haulage road I can only speak for my own particular pit. We only fire them at night when the men are out of the pit, and then we water on both sides of the shot.

12822. Do you consider that you are obliged to do that?—No, I consider it a precaution.

12823. It is voluntary?—It is voluntary.

12824. Conditions do not exist in your mine where you would be obliged to do it under existing regulations?—I do not think we should be bound to do so; but in our case it is a precaution.

12825. Who decides where the shot is to be fired and the weight of the charge? Is that left to some person who fires the shot in the haulage road?—Yes.

12826. Who has to decide that?—The deputy. The under official who is in charge of the work.

12827. A shot-firer?—Yes. In that case it would be done altogether by officials. It is done altogether by the officials.

12828. And between the shifts?—Yes.

12829. You do not do that when the men are at work?—No.

12830. Can you suggest any alteration with reference to shots other than at the face which might secure greater safety, alteration I mean in the existing regulations?—No, I am inclined to think that the regulations that we have now are sufficient for safety.

12831. The regulations now require that the shot is to be fired by a competent person?—Yes.

12832. Do you think it would be an advantage if in the haulage roads shots were not to be fired except under the immediate direction of the manager, who should have the conditions brought before him, and that he should prescribe whether the shot should be fired or not, or what weight it should be in proportion to the work he has to do?—Yes. In my own case shots are fired only by my sanction on the main haulage road.

12833. You said just now the deputy sees with regard to that?—That is the practical part.

12834. He has only charge of firing it. These shots are brought before you, and you decide whether they are to be fired or not?—Yes.

12835. That is not required now?—No.

12836. Have you a Special Rule in your district requiring that?—No, it is simply an arrangement of our own.

12837. Do you think it desirable that that should be made a General Rule?—Yes, I think it would be desirable if possible and practicable.

12838. Do you find in your own case that it embarrasses you at all, or that it is more costly to do that?—No.

12839. You think that might be made a General Rule which would induce safety without putting any additional cost on the management?—May I say I am only speaking for my own district, because in our district we do not have a very large number of shots on the main haulage roads. I am not acquainted with the practice in other districts where if they had very many I do not know how far that might be practicable. I would prefer to confine my remarks to my own district.

12840. If there are more shots there is greater danger?—Yes.

12841. Therefore one would think that it would be more necessary where there were a great number of shots?—That would be so.

12842. Speaking from your experience, you do not see any disadvantage, and there is a great advantage?—I consider that there is a great advantage in having that done.

12843. I understand that you disapprove of any regulation for universal watering?—I should very strongly disapprove of it. I say unhesitatingly that I have parts of my pit, which, if they had to be watered all through, I could not keep the roads open.

12844. You say that some roofs and sides would be absolutely destroyed by watering?—That is so.

12845. In the Kilburn seam?—I give Kilburn as an example.

12846. It is not a question of expense, but it could not be done?—I say that it is not a question of expense in that case; but to water roof, sides and floor of that as it would have to be done to absolutely destroy the dust would bring those roads in.

12847. Taking the Kilburn seam again, are the roads of such a character that unless specially prepared they could not be effectively swept and cleared of dust altogether?—Not in my case, nor in most of the collieries in my district. We work in what is called the longwall system where the roads are packed; the whole of the coal is taken out and packs substituted at the road sides, and these are all of such irregular character, built from irregular blocks of stone, that I think it would be impossible to sweep those absolutely clean.

12848. In order to prepare a protected area which could be kept clean, it would have to be by this barrel arch or by building walls alongside and a smooth roof?—I see no other possibility in our district.

Digitized by Google

12849. That would be very expensive ?—That would be very expensive indeed.

12850. You have some specimens of dust there you have collected ?—These were collected a day or two ago. I was trying to get the worst specimens I could.

12851. You have no analysis ?—No.

12852. You have brought specimens and you cannot say whether they are dangerous or not ?—No, I cannot say anything about that. I brought them simply to show the difference in dust that can be found on the same road.

12853. How do you do your haulage, by ponies or mechanically ?—Mechanical haulage on the main roads, ponies on the stall roads.

12854. (*Mr. Wm. Abraham.*) I suppose that you have had no experience in very dusty mines ?—No, I do not call our mines very dusty.

12855. Nor very dry ?—No.

12856. They are moderately dusty ?—And moderately dry I should call them myself.

12857. Where watering has been done, I understand you to say that it has been done for comfort, and not to prevent danger ?—Chiefly.

12858. The accumulation of dust on the road, which you find necessary to remove in order to expedite the travelling of the trams, is, in your opinion, not dangerous ?—I think not.

12859. The system that you have of watering to create comfort, you think, could be improved and made effective against danger ?—I do not think that our present system could, because that is chiefly watering the floor only.

12860. In Paragraph 6 (ii) you say, "I believe in my own case that a system of removal of dust plus watering, as is now carried out for comfort, could be made effectual." Effectual for what ?—I see what you mean. By extending the removing of that dust. If dust is to be looked on on the haulage road as danger under any circumstances, we should remove the dust rather more completely than we do now, and we should water a little more.

12861. So that you have had no experience in mines where there is dangerous coal dust ?—As far as I know, I think that our own coal dust is not so dangerous as this, at any rate.

12862. (*Mr. F. L. Davis.*) You have stated in your evidence that a number of your places, if you were to thoroughly water, would be closed up ?—Yes.

12863. I take it that at a number of places in your collieries you say that it is impossible to water ?—I do.

12864. Have you considered the question of watering zones, having wet zones at different parts of your colliery ?—Yes, I think that is a question which each colliery manager would have to answer for himself.

12865. As to where you would put them ?—Yes.

(*Mr. Cunynghame.*) In his own colliery.

12866. (*Mr. F. L. Davis.*) Do you think it would be practicable in your own colliery ?—In my own colliery I can see one or two places where if it has to be done it can be done; but I cannot speak as to other collieries. As I have mentioned, in the case of one of the seams, it would close the roads to water the roads in the seam itself. That seam is reached by means of a stone drift, going through stone, and I can see that in that case, if it was forced upon us, that I could water in that stone drift, but I could not water in the seam itself.

12867. Would there be any difficulty in that place you have just mentioned with the floor ?—In the stone drift ?

12868. Yes ?—No, not in that stone drift, not as regards myself. I am alluding now to the Kilburn seam, which I have given as an example. We reach that by a stone drift, and in that stone drift I admit I can see my way to water if it is made necessary; but as to watering in the seam itself, I could not keep the seam open and water the roads.

12869. It really comes to this, that if the question of zone watering were made compulsory, you say that there would be one or two places in your own particular colliery that you might adapt without great difficulty ?—I admit that.

12870. I take it that you still would say that the number of places for wet zones should be left to the manager of each colliery, or, rather, the decision as to how many he could have or where he could place them should be left entirely to the manager of the colliery ?—I do say so.

12871. (*Mr. Smillie.*) Would you say the same thing about carrying out the other provisions of the Mines Act, which was passed for the safety of the workmen, that it should be left to the manager whether he should carry them out or not ?—No.

12372. You would enforce the provisions of the Mines Act upon all managers. You do, as a matter of fact, now ?—Yes.

12373. You say you would leave the point of where there were to be watered zones to the manager, whether they should be there or not ?—I do not think, in this case, that that is the question that is before us. The question of having zones is not a question of the present Mines Act at all.

12374. I know it is not; but supposing an Act was passed to make it compulsory that there should be watered zones in dry and dusty mines, you would leave it with the managers concerned in the various collieries as to where they should be ?—Yes, I should.

12875. Would you have no provisions that there should be any places where they would be most effective to prevent the continuance of an explosion ? Supposing the manager put a zone between the pit bottom and 100 yards inbye, and said, "This is all I am going to put in," would you leave that with him to say so ?—I take it the zones are only to prevent the spread of an explosion from one seam to another.

12376. Or from one part of one seam to another part of the same seam ?—Yes.

12877. It would be necessary, if there were going to be watered zones to prevent the spread of an explosion for safety, that there should be certain definite and specific distances where the zones should be ?—Yes, I think the manager is the best judge as to where they should be.

12378. The manager is the best judge ?—I should say so.

12879. You would leave it with the manager ?—Yes, I should say so.

12880. You say that the stemming of a shot is a most important factor in causing it to blow out or not ?—Yes.

12881. Is the position of the shot not the most important as to whether it will blow out or whether it is bored in the solid ?—Certainly: I should never allow the shot to be bored in the solid.

12882. Do you undercut all your coal ?—Yes.

12883. How is it possible for you or the shot-firer to know whether or not a shot is bored over the top of the undercutting consequently in the solid ?—By the length of the fuse that is remaining.

12884. Can a shot-firer who does not see the whole seam know whether or not the hole is bored over the undercut ?—Yes, I say certainly.

12885. You would say that it would be dangerous as a matter of fact. Your answer to my other question proves that you believe that it is dangerous to bore holes in the solid for coal getting ?—I should say so. My experience of that is so.

12886. If that is done to any great extent at the present time, holes bored in the solid without any undercut, that would be a source of danger from blown-out shots ?—I should say so.

12887. You say it is of as great importance as the stemming of the hole itself ?—Yes, in that case.

12888. What is the extent of your collieries—I mean the extent of the area that you are working ?—Not a large area; several seams one over the other.

12889. 200 or 300 acres have you ?—500 acres.

12890. Are there any other proprietors working the same seam adjacent to you ?—Yes.

12891. Is there a barrier of coal left in between your workings and the workings of adjacent proprietors ?—Very small indeed.

12892. What size ?—A few yards.

12893. Is all the ground being worked by yourself and the adjacent owners ? Is it on the ground of the same owner ?—Yes, it is in another case.

12894. Supposing that you are bounding a colliery worked on the land of a different landowner, is it not common to leave a considerable boundary of coal between the two collieries ?—I have known it done and I have

Digitized by Google

Mr. G. S. Bragge.

7 Feb. 1907.

known it undone. I have known a barrier to have been left and afterwards taken out by mutual consent.

12895. You have known barriers which are left, I daresay, 50 yards ?—Yes.

12896. Between two adjacent proprietors' ground ?—Yes.

12897. Have you known barriers of coal left under a railway ?—Yes, under a tunnel ; I am working up to one now.

12898. Will you tell us what barrier was left in there ?—Not very much. What barrier from the tunnel ?

12899. What extent of coal—50 or 60 or 100 yards wide ?—I am speaking quite from recollection, but it would be possibly 70 or 80 yards wide.

12900. What length ?—Nearly a mile.

12901. Was that in the lease that that should be left in ?—It was simply our boundary line was drawn up to this line where the coal was sold to the Railway Company.

12902. (*Mr. F. L. Davis.*) It was sold to the Railway Company ?—Before we took the lease.

12903. (*Mr. Smillie.*) Before you began to work the pit ?—Before we took the lease of the coal we were working the pit.

12904. That coal is of course irretrievably lost to the country ? It cannot be taken out ?—No ; it cannot be taken out.

12905. It cannot be taken out now ?—It could not have been taken out at the time.

12906. It could have been taken out if you took it out as you went?—The Railway would not have been protected. It would be most dangerous to work that under the tunnel.

12907. That was left in in the interest of the safety of the tunnel ?—Yes.

12908. There have been considerable portions of coal left in under lakes and rivers and waterways at different parts of Great Britain ?—Yes, I believe so.

12909. In the interest of railway passengers and others ?—I believe so.

12910. Mr. Ellis put it to you, could you conceive a barrier of coal being left on each side of your main haulage road when you are extending your colliery, in order to build an arch there for safety, and you said you could not conceive such a thing ?—No, because in the case of a Railway Company the landlord gets paid for the coal.

12911. Supposing it was necessary in the interest of the lives of the miners that a certain portion of coal should be left in, do you not think that the lives of the miners are of sufficient importance to justify the leaving in of that coal ? I want to take a case in point ?—I am not a landlord.

12912. You are a Colliery Manager and deeply interested, I am sure, in the safety of your workmen, and you do all in your power to look after their safety. Supposing you take it that it is proved to the Government that zones, either wet zones or zones from which all coal dust has been removed, are necessary in the interest of safety underground, and you prove also that some seams of coal, because of the nature of the strata cannot be watered, would it not be necessary to build an archway there to make those zones ?—I say that it would ; there is no other way. If that is, as I say, forced upon us, that is the only way in which it can be done.

12913. Take it for granted that either dustless zones or wet zones are necessary to prevent explosions spreading, then it would be necessary to make an archway of some kind in a seam such as you have mentioned there ?—Yes, it would.

12914. If it is proved further that at a depth of 600 or 700 yards because of the weight of the strata above, that an arch in a longwall working, no matter how strong it is could not stand without pillars of coal left to protect it, would it not be necessary to leave pillars of coal to protect such an arch ?—I believe it would.

12915. Supposing the landlord stood in the way of such pillars of coal being left in, do you not think that the lives of the miners should be of more importance than his will, or a question of that kind ?—I call that a question of politics more than working.

12916. Is it not the question of the lives of one or ten men against the lives of thousands of men ?—I do not think it is in that case. I do not think that the landlord ought to be deprived of the value of his coal by a regulation that the Government has put upon us. The Government should pay for that coal the same as the Railway pays for the coal it requires for the protection of the works.

12917. You think the case is different ?—You have asked me, and I have given you my opinion.

12918. I might put it in this way ; 1,100 lives were lost in a colliery in the Courrières mines in France. Had it been possible to save 800 or 900 of those men by zones which had been made at the expense of the landlord by leaving some of the coal in, would it not have been worth while to do it ?—I regret the loss of life as much as anybody, but I think I have answered your question.

12919. (*Chairman.*) Do you wish to make any further statement ?—No, I think not ; I think all the points have been covered.

Digitized by Google

TWENTIETH DAY.

Wednesday, 20th February, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

H. H. S. CUNYNGHAME, Esq., C.B.
WM. ABRAHAM, Esq., M.P. (Rhondda).
ENOCH EDWARDS, Esq., M.P.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. WILLIAM HENRY ROUTLEDGE, called and examined.

Mr. W. H. Routledge. 20 Feb. 1907

The Witness handed in the following statement:—

12919A. (1) William Henry Routledge, Mining Engineer, Mem. Inst. of C.E., and Mining Agent for Messrs. Partridge, Jones & Co., Ltd., Colliery Proprietors, Monmouthshire, also an Examiner for Managers' certificates for the Southern District. Has had 37 years' experience of mines and had charge of extensive collieries in Monmouthshire for 20 years. Has been nominated by the South Wales and Monmouthshire Coal Owners' Association to give evidence before the Royal Commission particularly as to coal dust being found, and how it is dealt with upon the underground roadways of the collieries in Monmouthshire.

(2) So far as his knowledge goes, in Monmouthshire the question of coal dust affects chiefly the pits which are beyond a moderate depth and which require fairly large quantities of air passing along the roadways to the faces, to render harmless the firedamp produced.

(3) In the pits and levels of a shallow depth where little firedamp is produced, and not much air required to pass along the roadways, the question of coal dust does not in his opinion require much attention beyond the present regulations, especially as those shallow mines are frequently of a wet and damp nature.

(4) Has known and acknowledged the danger of coal dust being ignited upon the main roadways, and for several years before the passing of the Act of 1887, which required watering of the roadways before shot-firing took place, witness practised watering 20 yards of the roof, sides and floor before firing shots upon the main roads. Is of opinion that the most dangerous dust is to be found upon the roof, timbers and sides of the roadways of dusty mines.

(5) During the past 25 years has tried several means of dealing with the coal dust found upon underground roadways from a sanitary point of view, as well as from the point of view of safety.

(6) Has tried brushing of the roof, sides and floor with brushes, and gathering the dust into trams or tubs, and removing it out of the pit.

(7) Has not found this system satisfactory owing to the fact that an accumulation of dust must exist upon the roof, timbers and sides before the brushing could take place. There is also a large number of inaccessible places above the roof timbers where dust had accumulated and could not be removed by brushes, except at very great inconvenience and danger to the workmen.

(8) This system could only be done when the pit was idle, and no person allowed to work in the air current of the roadways undergoing the periodical brushing. Apart from the serious sanitary objection to this process, it was found that the brushing or raising of the dust caused a large quantity of the finest dust to be carried with the air current forward and deposited upon the interior portions of the roadways of the mine, and he is of the opinion that the depositing of this very fine dust on the roadways nearer the faces caused an increased danger by this method, and was fatal to its regular and general adoption. There could be no doubt whatever that the fine dust being carried nearer the faces intensified the danger in the event of an explosion. Does not now carry this out in practice.

(9) The next methods tried were watering with tanks.

1st.—A tank, fixed upon wheels to suit the gauge of the road, with simply a plug hole in the bottom of the tank, for watering a portion of the floor only. This was for sanitary purposes only.

2nd.—Tanks similar to above, with a spray pipe to whole width of the tank, which watered more or less the whole of the floor of the roadway and to a slight extent the sides of the roads. This was for sanitary purposes and an attempt to water the dust on the sides.

3rd.—Tanks similar to the above, but with gearing revolving a specially constructed wheel at a high velocity, which gave a spray of water thrown from the periphery of the wheel. This watered and laid the dust upon the floor, sides and roof to a slight extent.

This method was found more satisfactory from a watering point of view if the passing of the water tank along the roadway was done a sufficient number of times to saturate thoroughly the dust; but the practical effect was that, owing to the increased humidity necessarily being put into the air, the roof timbers rotted and had to be replaced more rapidly, and the strata composing the roof and sides of the roadway, especially if of an argillaceous nature, were injured, and caused many falls to occur, and provided a continual danger and expense in maintaining the roadway. The changing of the roof timbers so often also had the tendency to keep a continual movement upon the roof and sides, which intensified the danger to the men who had to repair the roads as well as the workmen and horses passing and repassing along such roadways. This system has ceased to be practised by witness.

(10) Another system tried was to saturate the main air current passing down the downcast shaft with exhaust steam, which was mixed with the air by an arrangement of small jets so as nearly as possible to mix the whole air current with the steam.

(11) This could only be done when the pit was idle, on account of the inconvenience of the fog caused by the steam, the fog often being inconveniently thick for some distance along the roadways from the bottom of the shaft. The effect of this attempt of saturating the air was for moisture to be deposited upon the roof, sides and floor, and it was satisfactory for a limited distance upon the roadways from the shaft from a watering point of view; but it had the same effect in rotting the timbers and of softening the foundation upon which the timbers rest and injuring the argillaceous strata which composed the roof and sides, and therefore

Digitized by Google

Mr. W. H. Routledge.

20 Feb. 1907.

caused an increase in the number of falls, accompanied with increased danger to the workmen.

(12) The present practice of witness is to have water pipes taking water under a high pressure from the shaft along the main intakes, the pipes having a tap every 40 yards on which a hose and spray can be attached and used by a man who is appointed for the purpose, and who waters the floor of extended lengths of roadway each day, and who makes a daily report as to the length of roadway watered each shift.

(13) From a sanitary point of view this is excellent if the watering is confined to the floor (of course supposing that the floor is not overwatered to cause it to swell and reduce the size of the roadway), but the same objection exists to water the roof and sides where the strata of the roadways are argillaceous and much timbering is necessary to make the roadway safe.

(14) The fine dust could be washed off the accessible places, but in practice the watering of the whole of the dust in an effectual manner is accompanied with the destroying of the timber and the roof and sides, and adding considerable danger to the workmen.

(15) Therefore the watering as at present carried out is more of a sanitary addition to the colliery than a preventative or mitigator of an explosion.

(16) Witness has nothing to suggest except that dust should be prevented as much as possible by keeping the trams or tubs dust-tight, and water as much as is reasonably practicable in the opinion of the manager; that is as far as can be expected in any regulations as based upon the experience gained in the many attempts which have been made this last 25 years to deal with this most difficult subject.

(17) Wet "zones" have been proposed which are said to be effectual in mitigating an explosion, but the "zones" would only be practicable in the majority of cases on roadways where the subsidence has ceased and some distance back from the faces. These "zones" might, in the event of an explosion, prevent the whole of the colliery being subject to the effect of the explosion, but could only be looked upon as additional precautions or as a mitigator. These "zones" would not, in witness's opinion, be a preventative. Any regulation, in witness's opinion, as to wet "zones" should be left to the reasonable discretion of the manager and should not be the subject of additional legislation. Witness's experience is that if General Rules were made to deal with watering they could not be reasonably carried out in many of the most fiery and dusty mines without increasing the danger from falls of roof and sides.

(18) Witness, while acknowledging that owing to the increased size of collieries and consequently increased volumes of ventilation and larger number of lives exposed to danger in the event of an explosion in some of the large and fiery and dusty pits the most stringent precautions should be adopted, but thinks that the present General and Special Rules, if rigidly enforced are sufficiently up-to-date to meet all known dangers in a reasonable and practicable manner.

(19) The Special Rules in this district have quite recently been revised, and the question of watering of the roadways, and an enforced second examination during each shift by the examiner or fireman of the working places in the shallow pits in this district, were the only points on which the coal owners could not agree with the mines inspector for the district.

12920–2. (*Chairman.*) Have you in your 37 years' experience of mines had any experience outside Monmouthshire?—I had nine years in Derbyshire, and previous to that I was in the county of Durham and also South Wales.

12923. Therefore, you have a very varied experience of mines?—I think so.

12924. You speak not only for Monmouthshire, but also to some extent for Durham?—I think so.

12925. And Derbyshire?—Yes.

12926. Does your experience in Durham and Derbyshire in any way conflict with your experience in Monmouthshire with regard to the coal dust? Are there any peculiarities in Monmouthshire?—Speaking of Durham, in my earlier days the question of coal dust never seems to have been discussed very much. That is going back 25 years, perhaps—25 to 28 years, but in my time in Derbyshire the question was discussed very frequently before the Chesterfield Institute of Engineers, and, in fact, extensive experiments were made by the Chesterfield Institute of Engineers which proved that coal dust was explosive.

12927. Your recent experience has been entirely in Monmouthshire?—The last 20 years.

12928. You say in Paragraph 2 that in Monmouthshire the question of coal dust affects chiefly the pits which are beyond a moderate depth. What do you call a moderate depth?—I should say anything exceeding 100 to 150 yards.

12929. Over 150 yards you think that the coal dust would begin to be a danger?—By reason of the firedamp being produced necessitating larger quantities of ventilation.

12930. And increased quantity of firedamp?—There would be an increased quantity of firedamp which would necessitate larger quantities of ventilation to render harmless the firedamp.

12931. It would be necessary to have more ventilation, because more firedamp is generated in the deeper seams?—That is so.

12932. As far as coal dust goes, I suppose the difference between the amount of coal dust in the higher seams and in the lower seams is not great. Is there much more coal dust in the lower seams?—Much more; due, I should say, considerably to the fact that it is necessary to have larger columns of ventilation entering the pit.

12933. The more ventilation you have the more coal dust is blown off?—Yes.

12934. From the face and everywhere else where you are working?—Yes.

12935. You say in Paragraph 3 that the question of coal dust is hardly a serious matter in the higher seams. Until you get down to a depth of 150 yards or so, the question of coal dust is not serious?—Not in the shallow mines.

12936. I say in mines of what you call a moderate depth the question is not serious, because there is comparatively little ventilation and comparatively little firedamp?—Yes.

12937. And there being comparatively little ventilation there is comparatively little dust blown about?—Yes.

12938. You say in Paragraph 4 the most dangerous dust is to be found on the roofs, timbers and sides of the roadways of dusty mines. The reason of it being more dangerous is that it is much finer and less mixed—purer and finer?—Yes.

12939. Then you say that you have tried various means of dealing with the coal dust, and in particular brushing the roofs, sides and floor with brushes, and gathering the dust into trams or tubs and removing it out of the pit, and that you have not found this system satisfactory owing to the fact that an accumulation of dust must exist upon the roof, timbers and sides before the brushing could take place. You also say that there is a large number of inaccessible places above the roof timbers where dust had accumulated and could not be removed by brushes except at very great inconvenience and danger to the workmen. So that, having tried this system of brushing you say that it is not satisfactory. Supposing you were to endeavour to deal with the dust by the zone system and that you considered it only necessary to keep certain parts of the mine as perfectly free from dust as you could, and supposing with a view to that you had certain roadways either arched or concreted in, in some way made smooth so that you could easily get at the dust, do you think a system of brushing away the dust might be effectual?—I have considered that point. I do not think that any system of brushing would be satisfactory in preventing the accumulation of dust.

12940. In the next paragraph you deal with the difficulty that would not be obviated by having archways or concrete or anything of that sort. You say that the brushing or raising of the dust caused a large quantity of the finest dust to be carried with the air current forward and deposited upon the interior portions of the roadways of the mine?—Yes, that is simply shifting dust from one portion of the mine to another.

12941. Supposing you had a zone that you did all your best to keep dustless, of 200 yards in length, and the whole of that 200 yards was brickwork or concrete, or something which would enable you to sweep it fairly clean, and supposing you did manage to sweep it fairly clean, would you say that the dust from the other portions of the road would so soon come in that it would render this dustless zone valueless as a protection?—I think the proposed system of dry zones is simply a fallacy altogether.

Digitized by Google

12942. What do you mean by "a fallacy altogether"? Do you think that 200 yards of dry zone, supposing you could get a dry and dustless zone, would or would not stop an explosion when it had once begun?—I should think not.

12943. You doubt if even 200 yards would stop an explosion?—Yes.

12944. You have no experience of that?—No. I do not think it has ever been tried.

12945. Judging from what you know of mine explosions, and you have had some experience of them I understand, you think it is very doubtful whether a dry dustless zone of 200 yards in length would stop an explosion?—I think so.

12946. You think also it would be doubtful whether you could make a zone dry and dustless for 200 yards and keep it so for any considerable time?—You could not possibly, in my opinion, keep a dry zone perfectly free from dust.

12947. Or so reasonably free from dust that it would be sufficient to stop an explosion?—I think not.

12948. Supposing an explosion was once started, do you suppose it would go through 200 yards of tunnel without any dust at all? Do you think that the dust raised by the explosion would carry the flame through a tunnel for 200 yards—is that your idea?—It perhaps may not be an answer to your question, but in my opinion I think that it is not possible to have a dry zone perfectly free from dust. Therefore, in the event of an explosion, I think there would be a certain amount of dust in the dry zone, which might possibly carry an explosion further.

12949. Quite independently of whether or not you could get a perfectly dry zone without any dust at all, whether theoretically there is such a dry zone which would be sufficient to stop an explosion or not, still you say in practice it would be impossible to ensure that zone should be sufficiently dustless to stop an explosion?—It is a question. It is a very important thing; but anything which engineers or managers can do towards making a colliery safe I am sure that they are always willing and anxious to do; and if it was felt by other witnesses that a dry zone would be of some service, I certainly recommend that the thing should be tried. Of course, we have no experience as to what the effect of a dry zone is.

12950. You go on to speak of the danger that you think might arise from the deposit of very fine dust on the roadways nearer the faces. You think if you begin brushing and sending the dust about the mine by trying to keep certain zones free from dust, that the dust must go somewhere by the ventilation, and that it might naturally find its way to the face?—Yes.

12951. Having done that, you would have greater danger from explosion near the face than before?—I think so.

12952. Now, I understand, there is very little danger of explosions near the face, and they generally take place along the haulage roads?—Chiefly on the main haulage roads. In my experience, the dust at the face is comparatively little compared with what it is on the main haulage roads.

12953. You have found this system of dealing with the dust and gathering it into trams and tubs and removing it out of the pit is not satisfactory, and you are so convinced of it that you do not do it now?—No.

12954. When you did take this dust away from the roofs and sides, did you wet it before you put it into the tubs?—Not at that time.

12955. You put it in dry?—Yes, and just shovelled it up from the floor along with the rougher stuff.

12956. Supposing you wetted it and put it in damp, the dust would not fly about nearly so much?—No.

12957. From the process of putting a lot of dust into the trams the dust would naturally find its way to the air; but supposing you damped the dust well before you put it in, then the dust would not be carried on by the ventilation air to the same extent?—That would have prevented it to a certain extent, but I might add that at that time we had not water pipes upon the roadways, so that we had no means of properly watering dust. It was simply a question of a dry sweep.

12958. If you had had water to put on you would not have put dry dust into tubs, but you would have wetted it first?—Certainly, if we had appliances at that time.

12959. You have not tried the system of wetting the dust first?—No.

12960. In point of fact the experiments carried out were not entirely satisfactory, because they were carried out under unfortunate conditions?—I am speaking of what happened 20 years ago.

12961. At all events, when you did make these experiments you did not carry them out under the most favourable conditions?—No.

12962. Do you suppose if you carried them on now with the water you have at hand in the pit, and that you were to damp the dust before putting it into the trams, that it would be an unsatisfactory mode of dealing with the dust?—I should think if we used water to damp the dust before putting it into the tram, no doubt the experiments would be much more satisfactory.

12963. You would almost entirely have avoided the difficulty you mention of driving the dust in on to the face?—To a great extent. I think a certain amount of dust would still be carried on to the face.

12964. In spite of all precautions?—Yes.

12965. You say in Paragraph 9 that you have tried watering with tanks, but only for sanitary purposes. Do you mean to prevent the dust getting into the men's lungs?—Simply to stop the dust being raised in the wind when the horses are travelling on the roadways.

12966. You tried a plug at first, and then you tried tanks with a spray pipe, and then a tank with gearing revolving a specially constructed wheel at a high velocity which gave a spray of water. You found that the spraying system was the most satisfactory, and you say that this method was found more satisfactory if the passing of the water-tank along the roadway was done a sufficient number of times to thoroughly saturate the dust; but then, on the other hand, you found that this spray rotted the timber, and that the roof timbers had to be replaced more rapidly?—Yes.

12967–8. And that the strata composing the roof and sides of the roadway, especially if of an argillaceous nature, caused many falls to occur. You say "caused many falls to occur and provided a continual danger and expense in maintaining the roadway"; but if you know the danger, and if you know how to guard against it, is not that sufficient? Do you find, as a matter of fact, that there are more deaths from falls of roof and sides where watering is used than where the pit is drier and consequently the roof more easy to keep up?—I do not know of any colliery, a dry and dusty colliery, especially in the steam coal seams, where watering is thoroughly carried out.

12969. Thoroughly carried out?—Where it is effectually carried out. Therefore we have no means of judging as to what the number of falls of roof would be; but, judging by what we find when we get quantities of water on different parts of the road accidentally, we find considerable expense in maintaining the roadway at those points.

12970. You say you find considerable expense in maintaining a roadway where it is wet, but my point was that you know what you have got to do to keep the roadway secure, and if you do that, although it may be very expensive do you think you would find that the danger to life is greater than if you kept the mine drier, and did not take all these precautions?—I think so, judging by what we find, as I said just now, as to the damage which is done to the roadway by water accidentally getting on the road.

12971. When you get these falls of roof and sides where there are fatal accidents, do you find that those falls generally occur in places where the roadways are very wet or where they are very rotten and where they have to be so much timbered to keep up, or do they occur just as often in other roadways that are supposed to be safer and less difficult to maintain?—The chief difficulty is where you have to have a lot of heavy timbering. There are two kinds of rot to timber I have found. There is dry rot which is due entirely to age, but we also have wet rot due to moisture in the air, and where you have heavy timbers, 10 and 12 ins. and sometimes 14 ins. in diameter, it is a very serious thing to rot that timber so quick.

12972. It is not a question of whether the timber is rotted or not quickly, but if you know how quickly it is going to rot it is as easy to replace it after six months as it is after six years. You test it and find after six months it has rotted and then you put up a fresh piece of timber?—In renewing that timber there is always a certain amount of danger to the workmen in the roadway. In fact, Mr. Martin, our inspector, in his last

Digitized by Google

Mr. W. H. Routledge.
20 Feb. 1907.

report draws attention to many accidents due to repairing the roads. If we do anything which would necessitate the timber being oftener changed it is quite certain we will get more repairs and more accidents.

12973. Do you say that a certain number of accidents takes place from falls of roof and sides during the process of repairing timbers?—Yes, and at times due to the natural disintegration in the strata from the atmosphere being damp.

12974. Can you not find out in time when this natural disintegration is taking place. Are there not any signs which show you that the disintegration is taking place, and that you must look out and do something to make the place safe?—We cannot always tell when a fall is going to happen.

12975. At all events, your opinion is that where you have a system of watering that rots the timber and that has a tendency to disintegrate the ground, whatever precautions you take the chances are you will have more accidents than in a mine which is drier, and consequently where the timbers last longer and there is not so much disintegration?—I am quite of that opinion.

12976. You cannot point to any statistics showing how many accidents occur in very wet seams from falls of roof and sides as compared with dry seams?—I do not know any dry and dusty mine which is thoroughly watered. Therefore we have no data to go upon except the experience we have gained by having water upon the roads.

12977. You say that this system of watering has ceased to be practised. I suppose you mean by "this system," the system of watering by spray?—Yes.

12978. From tank water?—Yes.

12979. Then you try to saturate the main air current passing down the downcast shaft with exhaust steam which was mixed with the air by an arrangement of small jets. You say this could only be done when the pit was idle on account of the inconvenience of the fog caused by the steam, and then that the effect was for moisture to be deposited upon the roof, sides and floor, and it was satisfactory for a limited distance upon the roadways from the shaft from a watering point of view, but it had the same effect in rotting the timbers and softening the foundations upon which the timbers rest and injuring the argillaceous strata, and therefore caused an increase in the number of falls accompanied with increased danger to the workmen?—Yes.

12980. Did you find that the death-rate from the falls went up?—We had more falls.

12981-2. And more deaths from these falls?—I could not say that we had more accidents, but we had more falls. There is more risk.

(*Mr. Ratcliffe Ellis.*) It might come down when nobody was there.

12983-4. (*Chairman.*) It does not seem at present that we have any statistics to show how far the rotting of timbers and the nature of the strata, and so on, have a bad effect upon the number of accidents, but it may be presumed that where you have all these difficulties in timbering and so on, that the accidents would be more numerous in places where the roadways were kept very damp and where they were not. That is apparently as far as one can go. There are no statistics showing how many accidents were due to falls from roof and sides which occurred in very damp roadways, and how many occurred in drier roadways, as far as I understand. Now, your present system is to have water pipes taking water under a high pressure from the shaft along the main intakes, the pipes having a tap every 40 yards, on which a hose and spray can be attached and used by a man who is appointed for the purpose, and who waters the floor of extended length of roadway each day, and who makes a daily report as to the length of roadway watered each shift?—Yes, that is the present system. We have in our largest colliery, I think, 6,000 yards of water pipes.

12985. You water the whole; you do not water in zones?—Yes, the whole 6,000 yards. We water the floor, not the roof and sides.

12986. If you only water the floor, there is no difficulty with the roof and sides, I imagine, except just the small damp that would arise from the floor; but that does not affect the roof and sides?—No.

12987. The only question is as to whether the floor will bear watering?—Yes.

12988. Supposing you found the floor did heave a good bit, how do you propose to deal with that? Would you have a brick floor, or what?—We have not found any difficulty with the floor, as long as we do not put on too much water; but if we put on sufficient water to damp the roof, sides and floor, I think we would get trouble with the floor.

12989. You have had no difficulty with the floor heaving so long as you do not drench the floor. Supposing you drench the floor only, do you suppose there would be any disadvantage in that? You think it would heave?—I think we would get the floor heaving.

12990. Now you water enough just to keep it moist?—Yes.

12991. That you find has no deleterious effect at all?—Not at all.

12992. I should have thought—I think some witnesses have put it to us—even if you only water the floor, you do a good deal by that means to do away with dust, because first and last the ventilation will probably move most of the dust off the sides and roof from time to time, and any dust that gets removed by the ventilation off the sides and roof will, to a certain extent at all events, deposit itself on the floor?—That is so.

12993. In that way you get rid of a good deal more dust by watering the floor?—Yes. I think by watering the floor it prevents a lot of very fine dust from being carried in the air current. I have just, within the last two or three weeks, had a very good illustration of the difference between having water pipes and not. During the heavy frost the water pipes got frozen in the downcast shaft, and for quite a fortnight we had no water to damp the dust on the floor of the main roads. During the very cold mornings we found the dust so very thick in the air that you could not see a safety lamp 150 yards away, the atmosphere was so charged with dust. That was upon haulage roads where the haulage is done by endless rope, and the speed of the trams is about four miles an hour, and the speed of the air current in several places may reach 1,000 ft. per minute.

12994. So that, in your opinion, the process of keeping the floor not drenched but just moist has a very considerable effect in clearing off the dust from everywhere, not only from the floor but from the roof and sides?—Certainly, because it is found that in some of the largest collieries in Monmouthshire the extension of watering by pipes is on the increase. I could give you some figures in connection with several of the big collieries.

12995. Lately the system of watering is on the increase?—Yes, it is on the increase.

12996. Watering the floor only, and not the roof and sides?—Watering the floor only.

12997. When you say "watering," you mean simply damping it and not drenching it?—Damping it. If I may be allowed to put in some figures as to the length of pipes in six of the largest collieries in Monmouthshire, I should like to. The Abercarn, that is the colliery where a very serious explosion happened some 30 years ago, 7,040 yards; Tirpentwys, 5,270 yards; Llanhilleth, 6,000 yards; Cwmbran, 3,000 yards; Tredegar Collieries, 12,000 yards; The Prince of Wales, 2,940; or nearly 20 miles of pipes for the six largest collieries in Monmouthshire. Now, going back less than 20 years ago there was not a yard of water pipes in any of those collieries for the sole purpose of laying the dust.

12998. You say that is simply done from a sanitary point of view, and not from the point of view of stopping an explosion?—I think keeping the dust out of the atmosphere has the effect of keeping the dust from going up the air current.

12999. In Paragraph 15 you say that the watering as at present carried out—that is, only watering the floor—is more of a sanitary addition to the colliery than a preventative or mitigator of an explosion. I should have thought to some extent it would have mitigated an explosion?—It will; but the very finest and, in my opinion, the most dangerous dust is found upon the timbers at the sides.

13000. According to your theory, watering the floor has something to do with dislodging the dust from the timbers?—To a certain extent.

13001. So that where you have the floor watered, even watered to the extent of being only damp, the air current dislodges a great deal of the fine dust, and when it gets dislodged a good deal of it is precipitated on to the floor?—Yes; there must be less dust.

13002. In that way you get rid not only of the inflammable dust, so far as there is any on the floor, but also you get rid of the more dangerous and inflammable dust to some extent on the roof and sides?—Yes.

13003. This system of watering the floors alone would

Digitized by Google

have some effect in stopping an explosion ?—It would tend to mitigate an explosion.

13004. Now about keeping the trams or tubs as much as possible dust-tight, what have you to say about dust-tight trams or tubs ? Are they reasonably dust-tight in Monmouthshire ?—The trams in Monmouthshire are closed in the ends and sides, but the coal is loaded from quite a foot to 18 inches above the top of the trams ; therefore, if anything was done in the direction of making dust-tight tubs, the sides of the tubs would have to be carried higher.

13005. You would be in favour of prohibiting the tube being loaded above the sides ?—Well, that would prevent a considerable quantity of dust from being blown from the top of the trams.

13006. There is now in Monmouthshire a good deal of dust on the top of the trams ?—A large quantity.

13007. Therefore, a good deal of dust deposited on ths haulage roads is due to dust tumbling off. not from the trams but from the top of the trams ?—Blown from the coal loaded above the top of the trams.

13008. You say that ought to be prohibited. You think it is a dangerous practice ?—It would mean a very great change to the custom in Monmouthshire if that was done.

13009. Supposing you had these trams 18 in. higher, and you could induce the men not to load them above the sides, that would not be very expensive, would it ?—It would not mean such a large increase of expense because the trams would prevent a lot of coal being wasted upon the road, that is coal tumbling off on the roads.

13010. Do you think that your trams in Monmouthshire are sufficiently dust-tight at the sides and floor ?—I think as a rule that the ends and the sides are.

13011. Fairly dust-tight ?—Yes.

13012. At any rate they ought to be made so, I suppose ?—I think, taking the large steam coal collieries, the design of trams is fairly dust-tight in the ends and sides.

13013. I see that the conclusion you arrive at—going back for a moment to the watering question—is that there should be as much watering as is reasonably practicable in the opinion of the manager. Therefore, you think that where the strata will stand watering it ought to be done ?—I think so.

13014. On the floor, roof and sides ?—I think in places roof and sides could be watered.

13015. You say "reasonably practicable in the opinion of the manager." Do you think the manager should be the only person to have a say in the matter ?—I think the manager goes much further than the Act does in many cases.

13016. I daresay he does, and that many managers may, but, possibly, some managers may not. I am not presuming to say what the view of the managers would be in the matter, whether they would be disposed to go further than the Act of Parliament as a rule or not, but one must legislate with the view to there being managers who are not likely to do so ?—I think the question of watering has received a considerable amount of attention, apart from any legislation.

13017. No doubt that is so, but you say "reasonably practicable in the opinion of the manager." Do you not think that not only the manager but, possibly, the mines inspector might have something to say to it ?—I think it would be quite safe to leave the matter entirely in the hands of the manager, because he is the man who is responsible under the Act for the safety of the mine. The inspector is not held responsible. The manager ought to be held responsible, and if he waters in certain places which causes more falls and more accidents then the manager must be held responsible.

13018. Your line of argument would lead us rather far, because if the manager, who is the responsible person, is to judge for himself what is to be done in the mine we need have no Mines Regulations Act at all. Why not let the whole thing be left to him ? It seems to me you are going rather far when you say because the mine manager is the responsible person that he should be entirely master of the situation ?—He is held responsible at the present time, and I think that the managers of the largest collieries are always quite alive to doing anything which will prevent accidents in a mine.

13019. Well, you are entitled to your own opinion. You think as regards the question of watering that it should be entirely left to the manager, and that the mines inspector should not have any say in the matter. He might have a say, I suppose, but if the manager disagrees with him you think the manager's view is always to prevail ?—I think, as a rule, in our district that where the inspector points out anything like that he has been always very fairly met. We have not had any difficulty in meeting the wishes of the inspector upon any general question like that.

13020–1. It may be so within your knowledge, but, possibly, cases might arise in which the mines inspector did not think he was fairly met. He might be right or wrong, but that might be his view. However, that is your opinion. You go on to deal with wet zones. You say they could be only looked upon as additional precautions or as a mitigator. No doubt the effect of wet zones would not be so much to prevent an explosion occurring as to prevent its being carried on if it did occur. On the other hand, the explosion can be prevented by watering, and has by Act of Parliament to be prevented as far as possible in the case of shot-firing ?—Yes.

13022. You would agree that the Rule as to watering near a shot ought to be carried into effect ?—In my own practice I carried that out before it was made law in 1887. When I was acting as the Certificated Manager I used to write a special permit for every shot which was fired upon the main roads, worded very similar to the words in the 1887 Act, as to firing shots on the main haulage road.

13023. I think we agree that additional precautions would only mitigate the explosion and would not absolutely prevent it happening, perhaps. No doubt, under a zone system, you might get a certain amount of after-damp, which would be carried through the wet zone and would be dangerous beyond it ?—That would not be so disastrous as having a huge explosion, in my opinion.

13024. Not nearly so disastrous. You are not in favour of General Rules dealing with the question of watering, except to the extent, I suppose, they have dealt with them as regards shot-firing ?—I think that the present rules with regard to shot-firing are quite sufficient. If they are strictly carried out I have no fear of any explosion happening from that cause.

13025. You say, in Paragraph 18, you think the present General and Special Rules, if rigidly enforced, are sufficiently up-to-date to meet all known dangers in a reasonable and practicable manner. The Special Rules are different in every district, I understand.—Yes.

13026. You mean your Special Rules are sufficient ?—Yes, our Special Rules for Monmouthshire. May I hand in a copy of the Special Rules for the district ? We recast these Rules about 18 months or two years ago, I should think, and spent a long time over it. It took nearly two years to do it.

13027. Do you think that some of those Special Rules you have in Monmouthshire, which you think are very desirable and carefully thought out, ought to be put in the General Rules to be enforced by Act of Parliament ?—I think there are many of the Special Rules which might be in the General Rules, and which might be made commonly applicable to the whole of the country.

13028. You say, in your last paragraph, that you have had a difference of opinion between the coal-owners and the mines inspector, and that the mines inspector wishes to enforce a second examination during each shift, by the examiner or fireman, of the working places in the shallow pits of the district. You, on behalf of the mine owners, do not think that is necessary ?—Yes ; we thought that it was not necessary.

13029. There is an instance of a difference of opinion between the mines inspector and the mine managers, apparently ?—I might explain why we objected to a second examination ; the seams which the inspector referred to had a rock roof, and were only about 18 ins. thick, and it was a most difficult thing, without seriously increasing the number of the examiners, to examine twice in the shift. In the steam coal seams we have two or three examinations of the men's places every day—twice by the examiner and once either by the under-manager or the overman, generally three examinations a day.

13030. (*Mr. Cunynghame.*) Could anything be done to prevent the timber rotting ? Is there any mixture such as Swedish tar or creosote that might be used for it ?—I have tried creosoted timber, but as you have to cut this timber very often to suit different places and different heights, if you once cut creosoted timber the creosote ceases to be a preventative to prevent it rotting.

13031. When you cut it ?—Yes.

Digitized by Google

Mr. W. H. Routledge. 20 Feb. 1907.

13032. Does not the creosote go through to the centre ?—The creosoting being done from the ends, it seems to open it out and does not prevent it from rotting. There may be some improved means since I tried it.

13033. If you watered in zones I suppose you might use iron rails in the zones, old railway rails ?—Yes, and walls, if necessary.

13034. I do not suppose you would put the rotting of timber as a serious objection to zone watering, at all events. There would be some way of getting round it ?—No, that is the next best thing.

13035. Steel props, or other things. I do not understand you put the rotting of timbers as a serious objection ?—It is a serious thing.

13036. It would not be so serious as to stop watering in mines ?—So serious as to prevent it being compulsory. You would have to make so many exemptions.

13037. I do not see what exemptions you could make if it is only a question of creosoting the timber whenever you cut it. You can have more creosote when you cut it, and creosote the ends only—in zone watering, mind. Do you mean to say that even in zones where you are to have watering that means of preventing timber rotting would be too expensive to undertake ?—I think that the zone system is the next best system.

13038. That is not an answer to my question. I am assuming the zone system is a good one. Do you think the rotting of the timber ought to stand in its way ? Do you put such importance on the rotting of timber as that ?—I think so. I think the rotting of the timber is a most serious thing in some of the steam coal pits.

13039. True, but ought it to stand in the way of zone watering ? Would you put it so high as that ?—No, I would not.

13040. Now, as regards brushing, I suppose that an infinitely small quantity of dust will cause an explosion really. Are you able, from your experience as a mine-owner, to answer that ?—It depends upon the quality of the dust.

13041. We will assume you have a thoroughly explosive dust—a bad dust—is it not true that an almost infinitesimal quantity in the air, almost like motes in a dusty room, will carry an explosion ?—It is very probable.

13042. Consequently, brushing alone I think you are inclined to consider inadequate ?—I think there is no system except effectual watering, if it could be done. I do not know any system except effectual watering.

13043. Have there been any plans tried for mixing anything with the water to lay the dust ? You know, for instance, with motor cars they have inventions on the roads to prevent the dust rising. Have you any sticky stuff in mind, glucose, or anything of that sort, that the main roads could be covered with to prevent the water evaporating ?—I have not tried it. I have seen common salt used.

13044. I suppose glucose or sugar would be impossible. It is cheaper than salt ?—I expect so, but I have not seen it tried. I have seen common salt tried, but only put upon the floor, and it did not damp the dust upon the sides and the roof.

13045. It was not sufficiently hygrometric ?—No, not sufficiently.

13046. That one would rather expect, that it was not sufficiently hygrometric, from the fact that in use salt is not very hygrometric. There is another suggestion made by Mr. Smillie, which is ingenious, that for brushing you might use some sort of sand blast. Have you heard of it ?—No.

13047. Perhaps we can ask him more about it if there is anything in it. You have 6,000 yards of watered floor ?—Yes.

13048. Are you able to tell us anything of the cost of that installation. I will not go into it unless you have the figures ?—Take 2 in. installation of pipes, that would cost 1s. 6d. per yard, and then there is a standpipe every 40 yards ; each standpipe costs 10d., and a 2-in. water-cock upon the standpipe costs 11s. 6d.

13049. Is there anything else—a hosepipe ?—Yes ; that costs 22s.

13050. Is there any other expense ?—The expense of laying it is 3d. per yard.

13051. (*Dr. Haldane.*) Do you have a hosepipe for each standpipe ?—No.

13052. (*Mr. Cunynghame.*) There is only one hosepipe for the whole mine ?—Yes.

13053. Laying 3d. a yard ; that turns the 1s. 6d. into 1s. 9d. ?—Yes.

13054. Is there anything else ?—That is the lot ; that is the cost of installation.

13055. It is under 2s. 6d. a yard the whole thing—well under ?—Yes, that is for a 2-in. range of pipes.

(*Chairman.*) 6,000 yards would be £1,000.

(*Mr. Cunynghame.*) About £750 or £800.

13056. For working it, what is the labour bill for watering the floor and all over ?—I should say that the cost of watering would work out at from 15s. to £1 per week per 1,000 yards of roadway.

13057. Supposing that instead of the road only you watered the roof and sides, what would that £1 come to ? It would cost more.

13058. I am asking you how much ?—You would have three times the area to deal with.

13059. Three times more, it would be £4 ?—I expect so.

13060. Then we get the cost of watering at £4 per 1,000 yards and the original cost of laying 2s. 6d. a yard. That is the whole thing ?—The cost of installation is trifling in a big colliery ; it is not the cost of installation which prevents it being extended ; it is the effect of the watering afterwards that prevents its being extended.

13061. Still, for your whole mine of 6,000 yards that would be £24 per week ; that is the whole thing ?—Yes.

13062. (*Chairman.*) If you only watered the floor the question of the roof and sides would not come in ?—No.

(*Mr. Cunynghame.*) I have the floor ; that is £1. If you do it all over the mine it is £24 a week for the whole mine, and the installation is about £800.

(*Chairman.*) Then he says he cannot tell you what more would be required for the cost of falls of roof and sides.

13063. (*Mr. Cunynghame.*) There will be repairs due to wetting of roof and sides ?—Yes.

13064. Supposing they did not thoroughly wet, but moistened in the way you have described ; you said there would not be many repairs of roof and sides from that, that it would not do much harm ?—I did not catch your question.

13065. I understood you to say if you did not thoroughly wet the roof and sides but only moistened them, that it would not cause many falls, but perhaps I am wrong ?—No, I do not think I gave that answer to the Chairman.

13066. There would be falls of roof if only moistened ?—Due to the damp atmosphere, due to the moisture in the air.

(*Mr. Smillie.*) That answer was given with regard to the watering of the floor.

13067. (*Mr. Cunynghame.*) You think it would cause a good deal more expense owing to repairs ?—Any moisture which is in the air is detrimental to any clay strata.

13068. (*Chairman.*) But not the moisture that arises simply from the floor having been kept damp. You say that does not injure the roofs and sides at all ?—It is so imperceptible that we do not see it, but if you charge the intake air with a lot of moisture by watering roof and sides, then you would get this damage to the clay strata.

13069. (*Mr. Cunynghame.*) How many yards of roadway are there in your mine ? The 6,000 yards does not represent all of it, I suppose ?—No ; that is three main intakes.

13070. How much other road is there in that particular mine ?—That would be a very big calculation. Do you mean the stall roads and faces and returns ?

13071-2. I will take those roads that you think might be watered in zones ?—I think the zone system, if it was found satisfactory, could be applied in the 6,000 yards.

13073. You think that the 6,000 yards you have got would cover zone-watering sufficiently ?—I think so.

13074. Of course, remembering with a zone system you have to carry the pipes from zone to zone ?—Yes.

13075. You think 6,000 yards would do ?—I think so. In looking over the plan of our largest mine, a mine which produces over 2,000 tons a day, it would take about five zones to meet what has been proposed by some of the witnesses.

13076. (*Mr. Ratcliffe Ellis.*) You spoke of some experiments at Chesterfield ?—Yes.

13077. That, you say, was 20 years ago ?—Quite, nearly 25 years ago.

Digitized by Google

13078. What was the character of the experiments?—They were made in a box; some experiments with gas and dust, and dust alone in an air current driven through these boxes.

13079. Is there any record existing of those?—Yes, there is a full account of all the experiments in the Transactions of the Chesterfield and Derbyshire Institute at that time—a very extensive account.

13080. Of a very exhaustive character?—Very exhaustive.

13081. Do you remember what conclusion they came to?—My recollection is that they proved that coal dust would fire alone without gas.

13082-3. Did you take part in those experiments yourself?—I was frequently a visitor, but I was not on the Committee.

13084. Did you agree with that conclusion?—I think so.

13085. Since that time have you seen any reason to alter your view about that?—No, not since then.

13086. Your opinion is that coal dust without gas would not create an explosion?—I think we are at cross-purposes.

(*Dr. Haldane.*) I think you misunderstand each other.

13087. (*Mr. Ratcliffe Ellis.*) I understood you to say that the result of these experiments with coal dust was without gas it would not cause an explosion?—I think I said that it would fire.

13088. Would it fire without some concussion, merely putting a light to it?—It would not fire without a flame being propagated into it suddenly, that is from a blown-out shot or from an ignition of gas. I have not heard of it firing by any open light in the mine.

13089. Have you seen on the surface coal dust put on a fire?—I have seen it put into the fire, and I have seen dry dust put into a coke-oven, but I have not seen it explode.

13090. What happens? Is there a flame?—Yes, but no violence at all.

13091. You think there must be either a blown-out shot or some concussion of some kind in order to cause an explosion from coal dust?—Yes, you must have a sudden flame; that is, a sudden hot flame either from a blown-out shot or, as I said just now, from an ignition of firedamp.

13092. That is to create it. Assuming there is an explosion you would agree that coal dust carries it on?—Certainly.

13093. And makes the result much more serious?—Most certainly. I have seen the result of several explosions, so that I know.

13094. Do you think it would be desirable that further experiments should be made with reference to coal dust?—I think the more knowledge we have of the subject the better. For my own part I believe that coal dust is dangerous, but a lot of people do not believe it.

13095. You said that it was when you got to a depth below 150 yards, that it became dangerous?—Yes.

13096. The dust is exactly the same dust in seams of less depth than in seams of greater depth?—Not so much dust.

13097. I mean the character of the dust?—The dust is not so mobile; that is, it is not so easily stirred up.

13098. Why?—In the shallow seams as a rule the mines are very wet, and they do not require so much wind to pass along them. It is the drying character of the wind that makes the dust.

13099. Why you say the deeper mines are more dangerous is because there is a greater amount of ventilation and the dust is blown about more?—Yes.

13100. Where do you find the greatest amount of dust?—On the main haulage roads.

13101. The fine dust of an explosive character?—On the main haulage roads where you are bringing coal in trams out against the ventilating current.

13102. Do you find it nearest to the face or furthest away from the face?—Nearest the pit bottom; that is, furthest away from the face.

13103. I did not quite understand what your difficulty was about dust being blown on to the face, because you find where you are coming against the air and the intake that the dust is further away from the face and not near the face?—If you brush dust away from the main haulage roads it is carried by the air current into the face. There is much more danger in the face owing to the shot-firing or to a defective lamp.

13104. In the ordinary course of things, although the air is blowing towards the face, you find that the dust is further away from the face?—Yes, but that is due to the face ever advancing, and not so much dust collected; where the haulage road itself is a permanent chimney, as you might say, for the soot to collect.

13105. These conditions would remain the same whether you brushed the dirt away or not?—Yes.

13106. To brush the dirt would alter the existing state of things, and instead of being further from the face and nearer the pit bottom it would be nearer the face?—It would increase the danger.

13107. And, therefore, render the face more dangerous?—Yes, because at the face you have more shot-firing and more lamps.

13108. Of course. You do not think that the dust can be satisfactorily removed?—I do not think so.

13109. Have you tried in a specially prepared area? You have only tried it upon the ordinary roads in a mine?—Just upon main roads and under ordinary conditions.

13110. You have no experience as to what can be done if you had a specially prepared area, a zone specially prepared for the removal of the dust?—I have no experience, but I do not think it is possible to make a dry zone free from dust.

13111. You do not think it is possible either that a zone from which the dust had been removed would start an explosion?—I think there would be still a certain amount of dust left sufficient for an explosion.

13112. If there was a case in which it had actually stopped an explosion you might modify your views about it?—Yes, but no one has had experience. Judging from the results of several explosions I do not think so.

13113. Would it not be more correct to say that you have not had any experience?—No, but I have read the accounts of several explosions.

13114. With regard to the effects of watering, do you find that there are some mines where watering can be done without any great mischief, and some where it could not be done at all?—Yes; but in some cases in Monmouthshire if there is any regulation passed for compulsory watering, *i.e.*, effectually watering the mine, I think it would stop the mine.

13115. Still the danger is there in these mines?—Yes.

13116. The deeper you go, probably the greater the danger?—Probably that is so.

13117. The deeper you go the greater the difficulty about watering to a certain extent?—Yes, but there are some roofs on main roads where the strata are more of a rocky nature, and you can water with impunity.

13118. There are cases, and I understand from you many cases, where watering would be impracticable?—If you take some of the main haulage roads in Monmouthshire in the steam coal pits you will find 1,000 pair of timber in less than 600 yards of roadway. It is a serious thing to disturb that timber.

13119. I take it from you that you look upon it as impracticable?—It is.

13120. What is to be done in cases of that sort?—The next thing is the zone system. We are all anxious to keep our collieries safe.

13121. The zone system in that case would want special preparation for the watering?—Yes, in some cases it would have to be arched, or, as Mr. Cunynghame suggested, steel rails and side walls, or something like that.

13122. If the strata was of such a character that you could not keep it up if you watered, arching would be necessary?—Yes.

13123. What are your deepest mines in South Wales, Monmouthshire?—In Monmouthshire the deepest is 550 yards.

13124. At that depth do you think you could maintain any arching of any length down there, or would not the pressure be so great that it would crush it in?—It depends upon the position of the arches. If it is close to the face in strata which had not settled, then you could not keep them, but if you put the arches back 400 or 500 yards from the face where the strata has ceased from subsiding, you might get the arch to stand.

13125. You are speaking of 400 to 450 yards. Take a mine double that, 800 yards deep, it would be hotter, and if there is dust there it would be more dangerous?—Yes.

Digitized by Google

Mr. W. H. Routledge.

20 Feb. 1907.

13126. Would you think arching practicable at that depth ?—It can be done, but it is very inconvenient on account of the times you have to keep renewing the arches. I have had no experience of pits over 500 yards deep, but I have been down collieries up to 800 and 900 yards deep, and from what I have observed it certainly costs a great deal to keep it arched.

13127. It would be a very serious cost ?—I think so.

13128. Can you suggest anything that might prevent the danger besides watering or removing the dust ? You admit the danger from this dust ?—Yes.

13129. Where watering is impracticable and the dust cannot be removed, can you suggest any other thing that might be done to render the condition less dangerous ?—Nothing, except strictly carry out the rules as to shot-firing, and as to discipline in the colliery and with regard to the use of safety lamps.

13130. Do you think that the danger can be prevented by any improvement in the shot-firing rules ?—I do not think so. In my opinion the present shot-firing rules are perfect if they are carried out. I do not know of any accident which has occurred under the present rules. When I say the present rules, I mean what is provided for in the Act of 1896, especially with high explosives.

13131. You have a rule that no shots are to be fired in the main haulage roads which are not sanctioned by you ?—Yes.

13132. That is not the Act of Parliament ?—No.

13133. Do you think that a rule of that kind might be made general ?—I think it might. I think, considering the number of explosions which are being said to have been caused by shot-firing in main roads, it is such an important thing that the agent, or no lower officer than the manager—not the under-manager—but the agent or manager, should give a special permit for every shot.

13134. Fired in the roadways ?—Yes.

13135. (*Chairman.*) Is that in the Special Rules ?—No, that is my own rule.

13136. (*Mr. Ratcliffe Ellis.*) Perhaps you are aware that in Lancashire there is a Special Rule of that sort ?—I think there is.

13137. You think that should be made a General Rule ?—I think so.

13138. Do you find that it is at all harassing or embarrassing to you ?—Not in the least ; in fact, I am more satisfied that I know when it is done myself.

13139. Supposing that rule were made general and it were carried out, would you anticipate any serious danger in a dry and dusty mine without watering ?—Not the least.

13140. You say in your statement in several places that you do something from a sanitary point of view. What does that mean ?—Chiefly to prevent dust being carried on to the men and the horses. It has the effect of reducing the amount of dust carried in the air current on the face as well.

13141. You do remove your dust, I suppose, to some extent ?—Yes, we keep it clean.

13142. Your view is, I understand, that supposing you keep it reasonably clean and do not let it accumulate, and you have your tubs constructed, as far as practicable, not to shed this dust about, and if you had the regulations as to shot-firing which you suggest, that that would be sufficient to secure reasonable safety ?—Ample.

13143. When you spoke about the responsibility of the mine-manager I do not understand that you mean to say that he should be absolutely free from all control by Act of Parliament or Special or General Rules ?—I never meant that for a moment.

13144. But if it is indicated in a rule what is to be done you would leave him a free hand as to how he should do it ?—Carry it out in a reasonably practicable way.

13145. Considering the varying conditions of mines, that really is necessary ?—I think so. If you made a cast-iron rule to suit all collieries it would be a very difficult —I would not say inconvenient, but it would be unworkable.

13146. (*Mr. Cunynghame.*) What is the output in this mine, roughly speaking, per annum in tons ?—I think the actual output is 620,000 tons per annum.

13147. (*Chairman.*) With regard to the spraying of the trams, you said one great cause of dust being deposited on the haulage roads was that a lot of dust was shaken out from the top of the trams and tubs owing to their being loaded above the sides ?—Yes.

13148. Do you believe in spraying the tubs. Do you think you ought to have a spray as they go along ?—I have not had experience myself, but at the Rhymney Company's pits the manager tells me that he finds that by spraying the tops of the trams before they leave the sidings to be hauled by the rope haulage, there is much less dust blown from the trams and less dust found in the roadways.

13149. Do you not think that would be a good thing to do in your colliery ?—It is worth considering.

13150. (*Mr. Cunynghame.*) You told me 620,000 tons per annum. Does that allude to the mine which has 6,000 yards of watering ?—Yes.

(*Mr. Cunynghame.*) I make it not quite 1d. a ton for the whole thing.

(*Mr. Ratcliffe Ellis.*) I will tell you where there is an error. You assume that it will last for ever.

(*Mr. Cunynghame.*) No, I have allowed depreciation and everything.

13151. (*Mr. Ratcliffe Ellis to Witness.*) What do you make it per ton ?—I have not worked it out. But that is not allowing for the extra falls which would be produced.

13152. (*Mr. Cunynghame.*) No, that would be allowing nothing for that ?—That is one of the questions with regard to the German system ; they give certain costs, but those costs must be to a certain extent hypothetical ; they cannot tell exactly what it would cost ; they cannot divide the costs out as to what is due to watering and what is not due to watering. I might say that the cost I have given is based upon invoice prices of what we have paid for our pipes, and I know exactly what it has cost.

13153. (*Mr. Enoch Edwards.*) Have you had much experience in explosions yourself ?—I have attended at several explosions. I was down in the Seaham Colliery shortly after the 1880 explosion. I was also at Claycross, of which perhaps you might know ; I was there four or five days after that explosion. I was also at Llanerch Colliery after the explosion, near Pontypool.

13154. Have you had such misfortunes in your own mine ?—No, never.

13155. So that at your own collieries you have had no such experience ?—Not at my own collieries. I was also at the Maclaren pits and at the Glyn pits, near Pontypool. I think that is the whole of my experience of explosions—it is sufficient.

13156. So that you have had no personal experience yourself of how far a dry zone may be made of such a character as not to continue an explosion ?—I have had no experience ; but, judging from what I have seen as the results of an explosion, I do not think it is possible for a dry zone to be effectual.

13157. I suppose if evidence was brought to your notice of what has actually happened, that dry zones have prevented an explosion travelling, you would be inclined to think it possible ?—Well, it would shake my opinion, certainly.

13158. You have had no means of gauging that point ?—None, except what I have seen of the results of explosions.

13159. I suppose we are agreed that what is meant by a "zone" is that an explosion shall not be fed over a certain area ?—Yes.

13160. The assumption is that it will die off by itself when there is nothing to feed it ?—Yes—that the supply of dust will not be sufficient to carry on the flame.

13161. Do you not think it would be possible, either by steel girders or arching, or some such method, to prevent an explosion passing over an area say of 200 or 300 yards without watering ?—I do not think so from the experience which I have had of previous explosions.

13162. But I understood you to say that you had had no opportunity of judging ?—No, I have been in collieries immediately after an explosion. I do not think it is possible to make a dustless zone.

13163. You are perhaps aware that in your particular profession there are mining engineers who have had experience and who say the contrary ?—I think the cases in which mining engineers would give such an opinion would be isolated.

13164. I rather gather that your evidence-in-chief is to the effect that you are opposed to watering ?—No, not at all. I am opposed to watering where the danger would be increased by extensive watering.

13165. You are perhaps aware that what has given rise to this particular phase of watering is the object of preventing, not so much an explosion at the coal face, but an explosion of dust throughout the workings ?—Yes.

Digitized by Google

13166. In consequence of what has happened in France, people have awakened to the fact that there is a possibility of that?—Yes.

13167. How would you, either with a dustless zone or a wetted zone, proceed to prevent this happening?—The chief thing, in my opinion, is to strictly carry out the rules as to shot-firing, and the next thing is to have strict discipline in the pit.

13168. I think you said in answer to Mr. Ellis that the present rules regulating shot-firing were ample if carried out?—Yes.

13169. (*Mr. Ratcliffe Ellis.*) With one addition, I think?—I think I would add to it that no shots should be fired in a main haulage road in a dry and dusty pit except by special permission of the agent or manager.

13170. That is only in the main haulage road: you would allow shots to be fired elsewhere?—Yes, elsewhere, with the ordinary precautions that are laid down in the Act.

13171. (*Mr. Enoch Edwards.*) Following this matter up for a moment, there has been a considerable number of accidents and great destruction of human life in South Wales and Monmouthshire during these last 10 years?—Not in Monmouthshire.

13172. In South Wales?—Yes, in South Wales.

13173. In these last two or three years, or three or four years?—Yes.

13174. Do I understand you to suggest that those accidents would not happen if the rules were carried out?—Well, in some cases the rules were not carried out.

13175. I put it to you because you were so emphatic in your answer to Mr. Ellis, that if these rules were carried out there would be no loss of life?—Yes. If you take the case of Wattstown, the rules were distinctly broken there.

13176. Inasmuch as this Commission was appointed with a view to preventing the destruction of human life, can you suggest what we should do or what we should recommend? If we have rules already to prevent it, what shall we do further?—Of course you will have the opinions of different witnesses, but I should say that if the discipline is increased a great many of these accidents would not happen.

13177. There are many of them which are preventable at the present moment, you think?—Yes, if the discipline were more strict.

13178. In regard to watering zones, did I understand you to suggest that there can be no uniform law laid down for application?—I do not think so.

13179. I think you do suggest that it must be left to the discretion of the manager?—Yes, I think so. In some cases the manager might do much more watering than any regulations might prescribe. Therefore, I think the manager should be allowed that discretion.

13180. Do you think it is possible to carry out a general law where you leave it to the discretion of the manager?—In this case I think it is so, because if there was effectual watering carried out, it would soon stop some of the collieries—you could not maintain the main roads at all.

13181. I put it to you that we have had witnesses before us who have been quite as strong in their opinion that an explosion may be prevented from being carried into other parts of the working of a particular colliery by dustless zones?—Yes. I think it would effect it. I think the zone system would be more practicable than any universal system of watering.

13182. But assuming that the Commission recommended zones, do you not think it is possible to so water those zones or to so deal with them as to prevent an explosion getting beyond them at all?—I think it would be. As to the length of the zones, I do not know. There may be great diversity of opinion on that point.

13183–6. Yes, there have not been sufficient experiments made?—No.

13187. You said that you for a long time have not permitted shots to be fired in the main haulage roads without your special permission?—Yes.

13188. That is not in the Rules?—No.

13189. I understood you to say you had revised these Rules up to date?—We have.

13190. Why was that not put in?—I cannot always force my personal opinions upon other people.

13191. But if this is such a good thing in the general belief and is so important, why is it not in the Rules?—Each individual agent and manager has his own fads about certain things and with regard to discipline.

Mr. W. H. Routledge.

20 Feb. 1907.

13192. (*Chairman.*) Upon the question of shot-firing, I see that in the Lancashire Special Rules, the new Rule, which was established about two years ago, provides this: "A shot shall not be fired on main haulage or main intake or main return roads except with the special permission in writing of the certificated manager"?—Yes. I think it is a very good rule, but I think I would go further and say "agent or certificated manager."

13193. You say you think it should not be fired on the main haulage roads; you do not include the main intake or main return roads, but only the main haulage roads. But you think that all the places where men are in the habit of going up and down a good deal should be included?—My rule only extended as far as the main haulage roads.

13194. What do you think of that; do you think it ought to be confined to main haulage roads, or do you think that main intake and main return roads should be included?—I am inclined to think that the Lancashire Rule is quite workable and I would recommend it.

13195. You would have it as in Lancashire, that it should not be fired on main haulage or main intake or main return roads; you would include all three classes of roads?—Yes, I think it would be a good thing to do so.

13196. You would not confine it simply to main haulage roads?—No. I think I should be prepared to support a Rule similar to the Lancashire Rule.

13197. (*Mr. Enoch Edwards.*) There is one further matter which I should like to ask your opinion upon. In working large and extensive collieries nowadays are there any efforts made to instruct the workmen as to means of escape in case of fire?—We have in some cases notice-boards showing the direction to the return.

13198. You are quite alive to the fact that many men's lives have been lost in explosions which need not have been lost if they had known of other ways out?—I think that many lives are lost by men trying to escape; if they stopped where they were many more lives would be saved. Of course the natural instinct of a man is to get to the surface out of danger, but his hurry to get out frequently leads him to lose his life.

13199. So that the safest thing is for him to stop, and therefore he does not need to know anything about the way out?—I remember a case in which 20 men in a group were found dead through leaving their places and meeting the afterdamp upon the main roadway. The chances are that if they had stopped in the faces they would have saved their lives.

13200. Has it come within your experience that there have been cases in which if the men had known the proper way to the return they would have saved their lives?—I do not know of any such case. They naturally make for the main intake; they take the road they know the best, and that is generally the most dangerous road they can make for.

13201. But if men were instructed so that they knew the return air-ways, where there is not so much danger?—I think that instructions or notices might be put up in many cases.

13202. But would it not be necessary for the men to be encouraged to travel along those ways sometimes?—Of course this is a matter which is personal to me; in my case I make all the men travel in the returns. I always find that if the men and horses are made to travel in the returns we have much better airways. But a great many mining engineers are strongly against that; they think it is dangerous to use returns for common purposes like that. Still, I must say for 20 years I have made it a constant practice of making returns the travelling ways, and found it tend to greater safety.

13203. (*Chairman.*) With regard to stopping at the working face when there is an explosion, I suppose the men run the risk, if they remain in the working face, of being cut off by some fall?—Yes.

13204. So that they might be injured there, and if they ran away at once it is possible that they might escape before a fall took place?—Yes; of course there are so many chances, and so many considerations come in; but, judging by what I have seen after explosions, if some of the men had stayed for about an hour or two in their places, and had not come out on the main haulage road and met the afterdamp, they would certainly have saved their lives.

13205. Therefore, supposing you were down in a mine

Digitized by Google

Mr. W. H. Routledge.

20 Feb. 1907.

at a working face yourself, and an explosion occurred, you think it would be safer to remain at the working face?—Well, I do not know what I would do.

13206. Even with your great experience, you are not sure what you would do?—I do not know at all. I might not practise what I preach.

13207. So that probably it would not be much use giving the men any advice with regard to doing what you have suggested?—No. It is a most trying ordeal to be in an explosion.

13208. (*Mr. Smillie.*) Have you known cases in which lives have been saved because of the fact that some of the persons had a knowledge of the return airway where they used generally the intake airway?—I cannot call to mind any case. I have heard of it being done, but I do not know of any cases in my own experience.

13209. As a general rule, would it not be a wise thing that the men should have a knowledge of both the intake and return airways?—Most certainly.

13210. You are here representing the views of the Monmouthshire Coalowners' Association?—Yes, and also the Mining Association of Great Britain.

13211. May we take it that the opinion of the Monmouthshire Coalowners' Association is stated in Paragraph 18 of your evidence. It practically means that the present state of mines is quite sufficient and that no new legislation is required. That paragraph says: "Witness, while acknowledging that, owing to the increased size of collieries and consequently increased volumes of ventilation and larger number of lives exposed to danger in the event of an explosion in some of the large and fiery and dusty pits, the most stringent precautions should be adopted"—then this is the point—"but thinks that the present General and Special Rules, if rigidly enforced, are sufficiently up-to-date to meet all known dangers in a reasonable and practicable manner"?—Yes.

13212. That means that the Monmouthshire Coalowners' Association are of opinion, and that you are now expressing that opinion, that no new legislation is required so far as dry and dusty mines are concerned?—Not with regard to watering.

13213. Well, with regard to anything else?—I think I have suggested that there might be an improvement with regard to the discipline as to shot-firing. If you made a thousand rules which were not carried out it would be no good. I think also that a great deal depends upon the general discipline.

13214. Are you of opinion that mines which are dry and dusty are more dangerous as to explosions than mines which are not dry and dusty?—Yes, of course they are.

13215. There are dry and dusty mines at the present time in which there are large accumulations of dust on the timbers and on the roadways?—Do you mean shallow mines?

13216. No, deep mines?—Yes, deep mines.

13217. Mines in Monmouthshire?—Yes.

13218. You are of opinion that nothing requires to be done but the strict enforcement of the existing Rules, with the addition of the precautions which you have mentioned with regard to shot-firing?—Yes.

13219. And your whole evidence might have been summed up in that—that in your opinion no new legislation is required, unless it is with regard to the more strict enforcement of the present Rules and the alteration with regard to shot-firing?—Yes; in Monmouthshire we have had no accident of that class; but if you take outside of Monmouthshire—take that last accident at Wingate, in Durham, there was a distinct breach of rules in that case. It is no use making a multiplicity of rules if they are not carried out.

13220. (*Chairman.*) But would you say, for instance, that if it was undesirable to have any Special Rules with regard to watering the tubs, it is a question worthy of consideration?—I think it is.

13221. Are you satisfied, in your own mind, that it would not be desirable to have a General Rule as to watering the tubs?—Anything that we can do towards rendering the dust innocuous is certainly tending to safety.

13222. So that, supposing you were to try this system of spraying the tubs and you were to find that it did diminish to a considerable extent the fall of coal dust on to the haulage roads, would you suggest that it should be made either a General or a Special Rule?—I think I would leave it to the discretion of the manager.

13223. (*Mr. Smillie.*) The Chairman suggested in one of his questions that practically all legislation has been made necessary not on account of the whole body of the colliery owners, but on account of the number who did not manage their mines in the best possible way?—Yes: the good people have to suffer for the bad.

13224. Do you agree with that?—That is so.

13225. And would you still leave the proposals which we are now suggesting to the discretion of the bad people?—I think that the present Regulations, if enforced, will tend more than anything else to decrease the number of accidents in mines.

13226. Many of the explosions which you have mentioned, which you yourself had experience of by examination afterwards, were caused by shot-firing?—I think so.

13227. How many of them—the whole of them?—No. Well, take the case of Seaham. This was due to shot-firing; take Claycross, that was naked lights.

13228. That was an explosion of dust?—No. Then Llanerch, naked lights; Glyn, naked lights. As to McLaren Pit, I do not know.

13229. McLaren Pit was not an explosion by shot-firing?—I knew that pit very well: I sunk it, but I do not know the condition of the mine after I left it.

13230. But you were there after the explosion?—Yes. If you take the principal explosions, there is no doubt that they have been caused by shot-firing, and not carrying out the Rules strictly.

13231. The principal explosions have all occurred in dry and dusty mines?—Yes.

13232. You say you think it would be a wise thing to put into the Special Rules which you yourself have carried out for some time, the prevention of shot-firing in main and haulage roads unless done by the special permission in writing of the manager?—Yes, I think that is necessary.

13233. Why would you put that into the Special Rules? Why not leave that to the discretion of the manager, if you leave other things to the discretion of the manager?—Well, as these huge explosions have happened so many times in the main roads I think that the agent ought to know exactly what is going on in the pit as well as the manager.

13234. But why not leave it to his discretion?—Well, it might be that in my case I have made myself responsible for it as agent. I have generally made myself responsible for such important matters.

13235. You have done a wise thing in doing so, but you could not get other managers to agree with you?—Perhaps not.

13236. And as a matter of fact the owners refused to put into your Special Rules a thing which you thought to be right?—No; that was not discussed.

13237. Still it was not put into your Special Rules?—No, but that addition was never discussed.

13238. It is 6,000 yards of main haulage road that you have watered?—Yes.

13239. You say that the 6,000 yards would be sufficient to put zones into all your workings?—Yes, in the 6,000 yards.

13240. Do you think there is any other part of your mine that would require to be watered than this 6,000 yards which you are dealing with?—No, I do not think so—not to carry out the zone system.

13241. Would the zone system, if tried in those 6,000 yards, be quite sufficient?—Judging by the experience that we have had in regard to other explosions, it would tend to mitigate a large explosion.

13242. Five zones of 200 yards each would only be 1,000 yards?—Yes.

13243. If it cost you £4 for your 6,000 yards it would only cost £1 for wages for doing the watering in your five zones of 200 yards each?—Yes, only in that proportion. But these zones which I assume might be put would be put at junctions with the roadways—not upon the straight road.

13244. No, at junctions of roadways. Is the bottom of the tram closed in your colliery as well as the sides and the ends?—Yes.

13245. What is the manager held responsible for. You say the managers are held responsible for the safety of the mine?—Yes.

13246. Has the manager in any case of any large explosion been held responsible for the explosion?—He

Digitized by Google

has been held liable to show that he had done everything that was possible in the matter.

13247. You say that the manager and not the mines inspector should be the person to say what methods should be taken to prevent dust being dangerous, because he is held responsible for the safety of the mine. Is he not held responsible only for the carrying out of the present Mines Act?—The manager is responsible for carrying out the Act. The mines inspector's duties are, I take it, to see that the Act is carried out, and he has no responsibility of any sort under the Act, except to see that the Act is carried out.

13248. So that if you do not put in any new clause into the Mines Act with regard to zones or watering, but leave it to the discretion of the manager, he would not be guilty of any breach of rule in the event of a serious explosion taking place?—No.

13249. Still, with that in your mind, you say that we do not require to have any new legislation on the question, but simply leave it to the discretion of the manager?—If you consider that without any legislation the principal owners of Monmouthshire have put in over 20 miles of pipes, I think that shows that the managers and the owners are as anxious as the inspector or anybody else is to keep their mines safe. Therefore I should say let the present good work go on without any compulsory or arbitrary things being done.

13250. Is it generally admitted amongst mining engineers, managers and owners, that coal dust, if not the initial cause of explosions, has carried on all the large explosions. That is admitted, I think, now?—Well, principally. There are some people who do not admit it.

13251. I suppose their opinion need hardly be taken into consideration against the overwhelming mass of opinion of others. It is generally admitted, I think we may say?—I think you will find some very old and experienced mining engineers in the country will not believe it yet.

13252. You mean that they will not believe that coal dust carries on an explosion?—By itself.

13253. I am not referring to that. But where an explosion takes place, the initial cause being either an explosion of gas or a blown-out shot, it is generally admitted that coal dust carries it on?—Yes. At the last Commission, of which I think Mr. Chamberlain was chairman, they took an immense amount of evidence upon the question of coal dust, and it was found a very difficult subject even at that time, and no regulations were framed except as to shot-firing, and I do not think there have been many new things discovered since then; so that it is a most difficult subject to deal with—that is to say, if you go in for effectually watering a mine, the chances are that you create more dangers by watering than there were before.

13254. That is not really the point. The point I am coming to is this; it is generally admitted that coal dust carries on an explosion?—I think the majority of people admit it.

13255. In spite of the fact that it is generally admitted that coal dust carries on an explosion when it once arises, is it not the case that in hundreds of mines in this country to-day the timbers, the sides, and the bottom are covered with dry dust which would carry on an explosion. That is so?—Yes.

13256. Are you still prepared to leave it in the discretion of managers to say whether that should continue or not?—Yes, I think so, because whatever rules you might make, if you recommend legislation, whatever it might be, if it is not carried out it is not effective. If the present Regulations are carried out that would make the mines much more secure.

13257. But would not that argument hold good as to every clause of the Mines Act? You say there is no use in making laws if they are not carried out?—Yes.

13258. That statement would hold good with regard to the whole of the Mines Act. I think it will be admitted that the Mines Regulation Act has improved the safety of mine workers in this country?—No doubt.

13259. And that had it not been for mining legislation thousands of lives would have been lost which have been saved?—I think so.

13260. Are you still prepared to leave it to the discretion of the managers to say what action shall be taken to prevent the spread of explosions? You are not prepared to suggest any change which should be put into the law?—Except what I have mentioned; that is, to make it more strict in regard to firing shots upon main roads.

13261. (*Chairman.*) There is one point I should like to put to you. A witness who is coming here to-morrow is prepared to tell us that he believes it is a fact that no explosion from dust has arisen where the present rules as to gas and shot-firing have been adhered to, and that the accidents which have occurred have been due to breaches of these rules. Would you be prepared to lay that down as broadly as that—that every case of accident from an explosion of a blown-out shot, or, I suppose, from a naked light, or from a lamp breaking, or anything of that sort, was due to neglect of rules?—I should not like to go quite as far as that. Going back as far as the explosion, say, at Seaham Colliery in 1880, I think it was due not so much to breach of rules as to ignorance with regard to the explosive nature of the dust.

13262. But now, with our knowledge of the explosive nature of coal dust, would you say that it was probable that no accident would ever happen, and that no explosion would ever happen either from gas or from coal dust if all the rules which are at present in vogue were carried into effect?—I think with regard to shot-firing, if the present rules are strictly carried out, we have absolute security, so far as I can judge. Of course in the case of a defective lamp being sent into a mine, or of a lamp becoming defective by getting the glass broken, that is not a breach of the rules.

13263. So that, of course, there may be an absolutely unpreventable accident, even although all the rules have been carried out to the fullest extent?—Yes, especially with a broken lamp.

13264. I suppose one case of that kind would be the case of a very bad explosion which was supposed to have occurred owing to a shot blowing out a lot of dust from a crack—the theory is that the shot was to some extent perhaps a blown-out shot and did not altogether do its work, and that it fired a lot of dust which was concealed in a crevice close to where the hole was drilled. I suppose that kind of thing could not be guarded against in any way?—No, that would be an accident; I can quite conceive that happening. But there must have been a certain amount of carelessness on the part of the man who was putting in the shot.

13265. Yes, you mean that there ought to be no case of a blown-out shot at all; that if the shot is put in and properly rammed, and so on, it should not occur?—And properly tamped.

13266. There should be no question of blowing out at all in that case?—Not with high explosives.

13267. Have you had many cases of blown-out shots?—Not for many years.

13268. You have not had a case for many years?—No.

13269. You consider that if high explosives only are used the danger from blown-out shots is almost nil?—I think so.

13270. Of course if it is a shot which does its duty and simply brings down the rock or coal that it is intended to bring down, there can be no question at all, I suppose, if it is properly damped, as to its being the cause of an explosion?—If the place is properly watered, in the event of a blown-out shot the dust would not become ignited.

13271. If a place is properly watered there might still be a question of dust in the cavity which had not been discovered?—But if there was dust in the cavity, if the place was properly watered, the explosion should not spread.

13272. So that even if there did happen to be a cavity which was not known, and that cavity was full of very explosive and fine coal dust, still if the shot was properly fired you think there ought to be nothing in the firing of the shot that could possibly produce an explosion of that dust even although it might be close to the hole?—I think the provision as to watering as provided in the Act of 1887 would be quite sufficient to meet a case like that.

13273. When you fire shots in the face do you water?—No.

13274. Then how do you read the Rule, because the Rule says: "in all dry and dusty places," and so on?—It wants explaining. We do not fire any shots in the face at all.

13275. You never fire shots in the face?—Not in the faces.

13276. (*Mr. Smillie.*) You have no brushing, have you?—No.

13277. That does not apply to the whole of Monmouth-

Digitized by Google

Mr. W. H. Routledge.

20 Feb. 1907.

shire?—No, there are a few places in Monmouthshire where there are no shots fired in the face—that is, in the steam coal pits.

13278. (*Chairman.*) You say there are a few places where they still fire shots in the face. Do you know whether in those mines they water around the shot or not?—In those cases I think they water.

13279. And you would agree, I suppose, that the rule required them to water in those places if they fire shots?—Yes; that is in accordance with the Act of 1887.

13280. (*Mr. Smillie.*) Those 18-in. seams are not in Monmouthshire?—Yes, but they are house coal seams, not steam coal.

13281. But you fire shots in the face in them?—Yes, in them; but there is no dust there. The seam as a rule is damp.

13282-3. (*Chairman.*) With regard to the question of shot-firing, would it be practicable in your mine always to take the men out of the pit when there was any shot-firing done?—In the main roads I would not allow any shot-firing except between the shifts.

13284. No shot-firing in the main haulage road during the shift?—No.

13285. Never?—Never.

13286. The men are always out?—Yes. But in the faces where there may be many shots required and where it is not so dusty, I do not think it is so necessary to get all the men out.

13287. The men must be there when the shot is fired?—Yes, they must be present.

13288. However, you have very little knowledge of shot-firing in the face, because you say it does not take place in your mine?—Not in the mine I am at at the present time.

Mr. William Walker Hood, called and examined.

Mr. W. W. Hood.

The Witness handed in the following statement:—

13288A. (1) The classification of dusty and non-dusty mines is quite possible, though difficult. Generally speaking, mines of less depth than 250 yards contain no dangerous dust, though I have known mines of only 100 yards in depth which, at some parts, contained dust highly dangerous.

(2) All coal dust is explosive, if pulverised enough. South Wales coal, owing to its conchoidal fracture, is more liable to pulverisation than the coals in any other coalfield that I know of in this country, though in most mines in Belgium a similar fracture obtains. I have never seen any conditions underground where it would be possible to initiate an explosion from a naked light only, though I have done so frequently on the surface by dropping a mass of extra finely ground coal on to a large flame, and in the bottom of a vertical box. Firedamp, of course, will start an explosion, and the higher the percentage of gas in the air, the greater will be the force of that explosion; but if there is no gas in the air the spread of a very serious explosion of coal dust alone will not be prevented. I have known a blown-out shot of black powder (but never with permitted explosives) cause a coal-dust explosion, when there was no gas present.

(3) Explosive dust is found in all parts of the mine, but in different degrees. The main haulage roads would, of course, contain the most dangerous dust.

(4) The sources of the dust are:—

(*a*) Sometimes from a rider of coal overlying the seam.

(*b*) Escaping through crevices in the bottoms and sides of trams which are only constructed of bars; but I do not know that there are many of these now in South Wales collieries.

(*c*) Blown from the top of full trams drawn against the ventilating current.

(*d*) There may, in some instances, be dust from the screens, where these are situated near the down-cast shaft, and where there is not a separate intake way other than the mouth of the shaft.

(5) Where the body of the trams is made of bars a considerable amount of small coal finds its way through; but I do not know any collieries where this prevails now. Covering the trams would not be a preventative, when one considers that the fine dust in our steam coal seams gets into one's watch. The only effective way is spraying the full trams as they start out to the shaft. In some instances in the collieries under my charge this operation is done three times, once at starting, once half-way, and again at the pit bottom. The intermediate watering, I may say, would be superfluous, were it not that I want to obviate the possibility of any dust getting on to the electric haulage machinery. The operation at the bottom of the down-cast makes it much more comfortable for the men working about the bottom of the shaft, as the speed of the ascending cage meeting the descending current brings dust out of the tram which has been made by attrition, after it was originally watered. There is far more dust from this cause than from screens. In the winter months, I may say, I use steam jets at the top of the down-cast shafts, the principal object of this being to raise the temperature of the air, and thereby make it capable of taking up more moisture, also with the object of saturating any particles of dust which might get down from the pit-top.

(6) (i.) I do not advocate complete watering, nor do I think it necessary; but in the mines under my charge it can be done on the main roads, and is done. The floors of many collieries would not stand it. In no part of the mines with which I am acquainted in South Wales would the roof stand watering, and very rarely the sides. In archways this, of course, is different. We use here for damping the dust sprays at intervals which are regulated by the size of the airway and the quantity of the air passing; hosepipes manipulated by workmen; water tanks with revolving jets, which can water the floor, sides and roof, or the floor only. The whole area only is watered in the roads, which are arched with bricks. Lastly, by spraying the full trams; this is the most effective way we have found for the prevention of the accumulation of dust, and has been in operation in the collieries under my charge for about 17 years, and was suggested to us by Mr. J. T. Robson, late Inspector of Mines.

Complete watering would mean a hot saturated atmosphere, which is extremely uncomfortable to work in.

(ii.) Partial watering of mines under *certain circumstances* would, in my opinion, prevent the spread of an explosion.

(7) The use of salt and non-inflammable dust or material is impracticable.

13289. (*Chairman.*) What is your experience in mining?—I am managing director of two colliery companies in South Wales, and part owner of a large colliery in Midlothian. I also practise as a mining engineer, and I have had 29 years' practical experience in the conduct of mines.

13290. In Midlothian and South Wales?—No; my responsible experience has been in South Wales.

13291. Not in Midlothian?—No, I have not had any responsible position in Midlothian except as a consultant.

13292. I understood you were a colliery owner there?—Yes.

13293. But you have had no responsibility in carrying on the mine there?—No.

13294. (*Mr. Enoch Edwards.*) Have you had much personal experience in colliery explosions?—Yes, I have had a great deal. I have been in the thick of from 15 to 18 of them. I do not know the exact number.

13295. Have you been so unfortunate as to have any of those accidents in collieries under your control?—I have not. I may have an accident at any time, of course.

13296. So that the experience which you have had of such explosions has been at collieries other than those managed by yourself?—That is so.

13297. You are fully aware that the main question which the Commission is considering now is the spread of an explosion and the destruction of human life in a mine far remote from the seat of the explosion itself?—That is so.

13298. And you are aware that the question which is being considered is one of watering mines?—Yes.

Digitized by Google

13299. Have you had much experience of watering mines?—A great deal.

13300. Have you had any experience of an explosion in a mine that has been watered?—Yes, in a mine that has been well watered.

13301. Does that experience lead you to believe that watering will effectually prevent the spread of an explosion?—Yes, under certain circumstances.

13302. What are those circumstances?—Well, until two years ago I thought a zone or a road watered for a certain distance would absolutely prevent the spread of an explosion; but since the Clydach Vale explosion my calculations in that respect have been upset, because there was at that colliery a road 700 yards in length, a timbered way, which was thoroughly watered, and yet the explosion came through it.

13303. The explosion came through 700 yards?—700 yards of well-watered road—a timbered road.

13304. When you say "well-watered" do you mean that the timbers were watered?—I mean that the timbers were absolutely close together, as close as they could be, and 10 days after the explosion, when we were first able to get into that road those timbers were wet. It was watered with a hose. That was the main road from the pit.

13305. Do you suggest that for 700 yards in length there would be nothing to feed that explosion?—No, I do not suggest that.

13306. You say it was after the explosion that those timbers were wet?—Yes.

13307. If the whole of those 700 yards of roadway were watered, the floor, the sides and the roof—— ?—Not the roof—the timbers: the watering could not get to the roof. It was bad roof, and there were falls above those timbers, and that is where the dust came from: that is my opinion.

13308. That there had been previous falls in that roadway?—Yes.

13309. You have a considerable amount of that in your South Wales mines?—Yes, a great deal of it. I have known the Clydach Vale Colliery for many years. It was a good roof originally, but working a seam or two seams under it made that roof so bad that it was impossible to arch it.

13310. You suggest it was the dust that lodged in those timbers that caused it?—Yes, and possibly pockets of gas too.

13311. I was going to ask you whether, inasmuch as the air could not get to it, and you could not ventilate, it would not be quite as likely that it was gas that exploded.—Yes, no doubt, because there were riders of coal above.

13312. (*Chairman.*) What do you mean by "a rider of coal"?—It is one small seam of coal lying above another.

13313. (*Mr. Smillie.*) Is that the name of that seam, "The Rider Seam?"—It is the "6-ft. Rider," we call it.

13314. (*Mr. Enoch Edwards.*) It is the term they apply in many cases to a seam of coal that is overlying another seam?—Yes, they call it the "rider" coal.

13315. It is pretty common in that part of the country?—It is very common.

13316. (*Chairman.*) I suppose there is a small amount of rock in between the seam you are working and the rider?—In that case it is, I think, 9 yards. Of course, it is always variable.

13317. (*Mr. Enoch Edwards.*) In that case, where you have taken out the distance from the seam below you have that 9 yards between, so that much will depend upon the quality of the roof; the trouble is that it comes down?—Yes.

13318. And it will come down to this coal sometimes?—It comes down to where the coal was.

13319. That is hardly what is meant, I think, when we talk about a watered zone; that it is a place where you have had falls and have left all those spaces above. You would hardly take that in the sense of meaning a tight-watered zone?—No; I would simply give it as an example of a road which formerly I should have thought was safe from my experience of watering.

13320. But you would not like to suggest that if that 700 yards of roadway had been what we understand to be a zone—that you could clear away the dust and that you would have no empty spaces in the roof above—an explosion would not travel 700 yards?—No; but I do not see how a zone could be made in that particular place such as you suggest.

13321. In that particular pit?—In that particular part of the pit; and that is the main artery, of course.

13322–3. But in this main length of the road you would not have an arch in that state, would you?—No; not if I could help it. But in this case if I were directing the management of that pit I could not help it, because of the seam being worked below it. It would shatter any kind of arches or any kind of support for the roof. We have such brittle roofs in our district.

13324. Had you seen this pit before the explosion?—Yes, often.

13325. You knew the nature of the roof along this road?—Yes.

13326. Did it ever occur to you before that that was not a tight zone?—No; I thought the watering would be quite sufficient, as the management did. It was extra well watered, and I thought it would make the place absolutely safe.

13327. Have you much of that sort of thing in the main roads of mines in South Wales?—A great deal.

13328. Nearer back to those points where you get, the object of course is to confine it to that roadway before you get to a junction with another road in another direction of the seam?—Yes.

13329. Would there not be sufficient area of good ground in any case to have it?—In no case.

13330. So that neither by watering all the way, nor by watered zones, nor by dry zones, could you deal with it in those particular seams?—No, because you could not water above those timbers; otherwise you would bring down the roof.

13331. Can you, from your lengthy experience, tell us what could be done?—In that case the only way would be not to work the seams below it—to leave a big pillar below it, so that you could arch that way or timber it right up against the roof and leave no cavities.

13332. Are these seams that you are compelled to blast in?—No.

13333. If you are not compelled to blast, and if you carry out the Regulation and keep it free from gas, where is the danger from explosion?—The danger from a miner's lamp; that is the greatest danger that I know of.

13334. That is assuming that he is working in gas?—Certainly.

13335. Your men do not work in gas, do they?—No.

13336. Then where is the danger?—Sudden outburst.

13337. In such a case as you are referring to, where you have had immense falls and where it has lodged above?—Yes, or even from a fall of roof I have known an explosion to be caused.

13338. At the working place?—Yes, near the working place. That is common, unfortunately. But what I referred to with regard to a miner's lamp, if I may explain, is this; you could get a miner's lamp in a perfectly safe position there (*describing*), and then a slight fall from the roof may come down and bring a little gas with it, and the fall knocks *there*, and that breaks the lamp glass but does not extinguish the flame. If you consider the number of lamp glasses that are broken in the course of a month in a colliery it is astounding, even although you are careful to investigate every case. I think we have something like 400 in a month.

13339. Out of how many?—Out of 3,000 daily. We investigate every case to see what the reason of it is.

13340. Of course in the occupation itself there is a considerable amount of risk of that?—Yes, no doubt—hauliers principally.

13341. Have you known yourself many cases of explosion through falls on a miner's lamp?—No, I only recall one, from the cause I have told you of, and that was in a seam where safety lamps were only partially used.

13342. I notice you say in your statement that you agree that partial watering of mines under some circumstances would prevent the spread of an explosion?—Yes.

13343. You think that complete watering throughout a mine is impracticable?—Throughout the mine it is quite impracticable; that is to say, taking the German Rules for instance, I say that we have adopted the German Rules for many years, but we would be granted exemptions where they are granted exemptions.

13344. On what grounds?—On the ground that the roof and sides would not stand it. I read a paper in February, 1902 (which I have here), showing the differences

Digitized by Google

Mr. W. W. Hood.

20 Feb. 1907.

in temperature and humidity, and it shows our system of watering pipes, which is just as good as the Germans are doing now.

13345. Are we right in assuming that since you have so watered you have had no explosion?—We have had no explosion, but I wish I could feel sure that we could not have one.

13346. But you have not had one?—No: I wish I could feel that we are absolutely free from explosions. Notwithstanding the great expense and the great trouble that we take in watering, I do not feel certain. I thought we were free from the risk of explosion before the Clydach Vale experience.

13347. You thought up to then that you were safe?—We thought that we at the Glamorgan Collieries were absolutely safe, and I should have said until the day of the Clydach Vale explosion that they were absolutely safe too, except that we have much greater lengths of roadways arched than they have.

13348. Those lengths of roadways which you have arched you can make dustless zones?—Absolutely.

13349. And water them?—Yes, roof, sides and floor—water the whole lot.

13350. So that you do it at your Colliery?—Yes, certainly; but I do not water the roof and very seldom water the sides in any part that is not arched—I cannot.

13351. With regard to the portion which you have arched, how do you proceed: what is your method of keeping it dustless? Is there any attention paid to it: is it brushed down or what?—No; if you prevent dust from going there there is no need to brush it.

13352. In your judgment you do effectually keep it out?—I think so; but I know that a very small quantity of dry dust and light dust such as we have will carry an explosion. What we do is to have jets going night and day, and beyond that we have hose, and on the top of that we have a tank like a boiler, with a revolving nozzle, which sprinkles the roofs and sides, and when it gets out of the archway you simply put down a flat sheet of iron and it does only the floor and about 2 ft. of the sides.

13353. In the instance of the Colliery which you mentioned, and which you say shook your faith, you do not suggest to us that if they had had such a watered zone, arched as you have it, that flame could have travelled 700 yards?—It could not, in my opinion—nor half 700 yards.

13354. So that you agree with those who have expressed the opinion here that if you have a completely watered zone, arched say for a much less distance than 700 yards, that would prevent its spreading?—Yes.

13355. That is to say, there would be nothing to feed it or to carry it on?—There would be nothing to carry it on, and the length of that zone would be determined by its area and the quantity of air passing through it.

13356. But in consequence of these heavy falls in the roadways you think you have collieries where it would not be possible to carry it out?—Yes, many. I can give you an example of ours where we had 1,500 yards of roadway arched, and every one of them has had to come out, so that we can only do our spraying and watering of the floor there now.

13357. Does that arise through working one seam under another?—It does—at a distance of 110 yards. We made a beautiful road with 12 ft. arches, and it was simply a crushed rat-hole afterwards.

13358. So that you have taken the seam out underneath?—We have taken the seam out underneath.

13359. You may have that difficulty in opening out all new collieries?—In that case we could not have worked our colliery; we could not have got the quantity of coal to cover our general charges.

13360. (*Mr. Ratcliffe Ellis.*) You not only have had a good deal to do with mines in this country, but you have seen a good deal of mines abroad?—I served most of my apprenticeship abroad, and I have seen mines abroad periodically since.

13361. Where?—In France, Belgium and Germany.

13362. So that you bring to bear upon the question experience which has been obtained abroad as well as in England?—Yes.

13363. You are familiar with the German system of watering?—I am.

13364. Taking it generally do you think that could be made applicable generally in England, that is to say, universal watering?—Not from what I know. It certainly could not in South Wales. I do not know so much with regard to English mines during the last 10 years.

13365. There would have to be a great many exceptions?—Yes, they would be nearly all exceptions with us.

13366. You say that a classification of the dusty and non-dusty mines is quite possible?—Yes.

13367. Will you state exactly what you mean by that?—Perhaps I have not expressed myself very well in my statement. What I mean is that I should be able to tell when I went down a mine whether that mine was dry and dusty, and any mining man ought to be able to say. But I do not see how a fixed rule as to depth could be applied, because, as I say, our No. 3 seam, which is only 100 yards deep, has long lengths of roadways with dangerous dust, and these I have watered.

13368. You could not say that it might be defined by depth?—No.

13369. But is there any way in which it could be defined? Well, if it were dry and dusty and if the dust were fine enough.

13370. Is it possible to classify coal dusts which are dangerous and coal dusts which are not dangerous?—Yes. If coal dust finds its way through your watch case, as it has in this one, it would be dangerous (*Witness produced watch*). I have brought that watch here from one of our under-managers.

13371. Is that an instrument which would show it?—No, it is only an ordinary watch which I have brought with me to show how dust goes through the case. This is an example of the uselessness of a boxed-in tram, which I notice is advocated by some witnesses.

13372. (*Chairman.*) How long does it take to get that amount of dust in the watch?—The under-manager from whom I have brought it does not think he has had it cleaned for seven or eight months.

13373. Then you would consider that the distinction between a dangerous dust and a non-dangerous dust is in its fineness?—Yes, distinctly.

13374. Is there dust which is dangerous attributable to every seam—does every seam produce a dust which is dangerous?—No.

13375. Then do you think that there are some seams which produce a dust that, although very fine, is not so dangerous?—Quite so. Still, I must qualify that by saying that that dust must be damp. I believe that you could fire any coal dust if you could get it fine enough; but I believe there are many seams, particularly in the north of England and in Scotland, where you could not grind it fine enough to get it to explode, because the coal has a cubical fracture and not conchoidal like ours.

13376. The arching which you spoke about would enable you, if it could be maintained, either to have a dustless zone or a wet zone, and either one or the other might prevent the extension of the explosion?—Yes; I think if it were in an arched way it would prevent it.

13377. There has been no evidence so far before us as to the length of zones necessary to stop the effect of an explosion?—No.

13378. There could be no rule applied, so far as you know, now?—No, but I have known cases where watered roads alone and timbered roads have stopped an explosion, although the case of Clydach Vale breaks my rule.

13379. You have not been able to find any distinction or difference in this case to account for it?—No, except perhaps those holes above the timbers might have been greater than in the other cases.

13380. Do you think it desirable that experiments should be undertaken on a large scale to see what length of a dustless zone or what length of a watered zone is sufficient to stop an explosion spreading?—It would be very interesting, but I should not like to give my pits for the purpose.

13381. No, if you could get someone else's pits you think such experiments would be very useful?—Certainly.

13382. Would you say all coal dust is explosive?—All dry coal dust if a certain degree of fineness were attained.

13383. All coal dust is explosive. Will a light cause an explosion?—Yes, under the circumstances I have already given.

13384. There will be an explosion if a light is put to it, you think?—I know our dust would cause an explosion.

13385. Without any gas at all?—Yes.

13386. You have a reason for that, I am sure?—Yes.

Digitized by Google

13387. What is the reason?—It can be done by experiment. It cannot be done in a pit unless you take down the things to do it with. You must get very fine dust that has been ground—the stuff that is floating about from the grinding mill; take that off the beams, and then drop it down from a height on to a big lamp or "comet," and then you will get it to explode about once in twenty times. But I have never known a case in a pit where a naked light has exploded dust, and I have seen it thick sometimes after a heavy fall.

13388. What is the reason for that difference—that it will do it on the surface and not down below?—Because you can get a bigger light to begin with, and you can get it all fine dust. You cannot get all fine dust underground.

13389. Then do you think there is no danger of an explosion of coal dust down below except by having a light put to it?—I do not think so. I have never seen a case as to which I could state that such a thing would happen.

13390. Do you think it is possible to have a pure coal dust explosion down below without some gas?—Yes.

13391. Then how would that arise?—By a blown-out shot. I have known it happen.

13392. Have you tried any system of collecting the dust off a prepared zone—having a distance prepared so that you might clear the dust away from it?—Yes, I have tried it. You cannot clean it.

13393. But have you had it arched?—Yes.

13394. Why could you not clean it off?—If you sweep it off from one bit, as soon as you have finished one bit it would be on another. The only way is to wet it, I think—to water the dust.

13395. In your view the only way to render this dust harmless is by watering?—Yes. It is by far the cheapest and most effective way.

13396. Have you any information which you could give the Commission as to the cost of doing that?—Do you mean the cost of our watering?

13397. Yes?—We have 14 miles of pipes. I went into all the costs and we checked them yesterday. The cost was about 1¾d. for last year, that is the direct cost.

13398. Do you mind saying what that would include?—Pipes, renewals, workmen, taps, the people with the sprays and the men with the hoses and everybody connected with it.

13399. 1¾d. per ton?—Yes.

13400. Is that over the whole 14 miles of pipes?—Yes.

13401. That is practically the whole pit?—The three pits.

13402. Then what is the indirect cost?—The indirect cost is very difficult to get at.

13403. What items would it represent?—It would represent repairs.

13404. What particular charges?—Extra repairing.

13405. That is extra repairing of the roads?—Yes, I have gone into it with my managers and they think the whole thing is not done, including that 1¾d. per ton, under about 5d. per ton. In taking that figure, I do not think we are wrong. I think we have erred on the lower rather than on the higher side.

13406. (*Mr. Cunynghame.*) Have you allowed for depreciation merely?—No, I do not take depreciation. I have no capital account or depreciation, because when a pipe bursts or is worn it is renewed; therefore, I have no capital account.

13407. (*Mr. Ratcliffe Ellis.*) But you charge for that, for the renewal?—Yes, but it is for the upkeep.

13408. (*Mr. Cunynghame.*) But have you charged interest on capital in that account?—No.

13409. That is the yearly expense?—That is the yearly out-of-pocket direct expenditure. The 5d. we think would cover the whole of it, because where the roads are watered, say at the double partings, there is a continual upheaval of the bottom and there we have to cut bottom very frequently.

13410. (*Mr. Ratcliffe Ellis.*) That is your actual expenditure—5d. per ton is what it costs you for watering?—Yes.

13411. Have you any suggestion to make as to preventing the accumulation of dust?—Yes. The only effective suggestion I have to make is watering the trams, because most of the dust comes from them.

13412. Is there any suggestion that you have to make as to the construction of the trams?—The bottom part should be as close as it is possible to make them. Formerly in South Wales they were mostly bars, but now I do not know any of that pattern, what we call screen trams. Of course, we must pile the coal up above the level of the top of the trams, and the empty trams should be watered as well as the full ones.

13413. Does that watering damage the coal at all?—If you put too much water, distinctly it does.

13414. Can you put a sufficient quantity on to be effective without damaging the coal?—Yes.

13415. Do you think there is any serious quantity of dust going down the pit from the surface?—Yes, if the trams are not watered at the pit bottom.

13416. It goes down the pit from the screen?—But the amount is infinitesimal.

13417. You do not think that is serious?—Where you take the slightest precaution, that is to say, where you have your screens on the top of the pit, you must make another intake archway at the opposite side from the screens.

13418. Then you think it is necessary to take some precautions to prevent the dust from the screens going down the pit?—Distinctly; but it is an infinitesimal amount of dust.

13419. Is it general that precautions are taken to prevent dust descending the pit?—No, I do not think it is general. I mean to say people might come to my place and they might never see the precautions I take, because I have jets of steam in that intake archway at the opposite side of the pit from the screens.

13420. Then you look upon the coal falling off the trams as the principal cause of dust?—Dust caused by the rush of air on the trams that are going against the air current.

13421. Do you clean the dust periodically?—Yes, we clean it up in the form of mud, of course, but not of dust—we never think of cleaning it as dust.

13422. You rely upon the watering as being sufficient?—Yes.

13423. In mines such as you have described, where you would be working a mine below where the arches are, it is practically impossible to have those arches. You would pull them all to pieces?—Yes, or you can continue renewing them.

13424. It would be very costly?—It would be very costly. What we do is to renew them after those workings have gone on, because we believe in brick arching.

13425. In mines 700 yards or 800 yards deep would it be possible to maintain the arches?—It would be very difficult.

13426. You quite appreciate the danger of the existence of coal dust?—Yes, I have done so since 1878, and I have taken precautions since 1878.

13427. You read a Paper on the subject?—Yes; that was in 1892. I gave evidence before the Coal Dust Commission previously, but I have not had time to look up what I said. Of course, I had not so much experience on the subject then as I have now.

13428. Do you think any regulations might be made with reference to shot-firing which would minimise the danger of explosions?—No; I think the danger from shot-firing is minimised as much as it can be now. There are not only the precautions, but also there are the permitted explosives, and people know the danger of shot-firing, and they fire as few shots as they can.

13429. I suppose there are cases in which it would be impracticable either to have dustless zones, where they could be cleared from dust, or areas watered—watered zones? There might be, and no doubt there are, many cases where neither one nor the other could be used?—Yes, but where a shot is fired——

13430. I was going to ask you about that. Supposing there are cases where neither watering nor zones cleared of dust could be constructed or done, could anything be done in the way of regulating the shot-firing arrangements in those mines?—No. I would not fire a shot in our mines without that.

13431. Do you think that where you could do neither one nor the other and where it was a dry and dusty mine shot-firing should be prohibited?—Well, I would not do shot-firing. But I do not know of a case where you could not water sufficiently to prevent danger from a shot—because very little water will prevent the danger in the initial stage.

Digitized by Google

Mr. W. W. Hood.

20 Feb. 1907.

13432. You are familiar with the regulations now existing in the Act as to shot-firing and also in the Explosives Order. Is there anything that you can suggest in addition?—No, I think they are very good.

13433. What is your practice with reference to firing shots in either the intake, the haulage roads, or the main roads in a mine. Do you have those shots fired under the immediate direction of the manager?—Yes.

13434. He decides where a shot is to be fired?—Certainly. He decides where every shot is to be fired.

13435. That is not provided for in any rules now?—No.

13436. Do you think it is desirable to have that provision made?—I think well-managed mines generally make that a rule.

13437. Do you think that is a rule which ought to be observed?—Well, so long as I carry it out myself I cannot say the opposite.

13438. Then do you think it would be desirable to make that a General Rule?—I think so.

13439. In regard to the methods of watering, are there various methods adopted?—Yes, but I do not think any collieries do more than we do: we do them all.

13440. It was said by one of the witnesses that he had been in one of the South Wales mines which was supposed to have been watered and if he kicked up the dust a cloud of dust came out?—No doubt.

13441. Is watering such as that effective?—No, but that you might find in any mine, in parts of it, at any time. That is why I water all my main roads and returns, for fear of a defective pipe, so that I shall have a zone somewhere.

13442. What is your recommendation with reference to watering? You would not recommend watering the whole of any mine?—No, certainly not. I do not think it could be done.

13443. Would you recommend that there should be compulsory zones in all mines?—Yes.

13444. Either watered or cleansed from dust?—Yes. I do not say in all mines, but in dry and dusty mines.

13445. Could you suggest, if it should be done in zones, where the zones should be: or would you leave that to the management?—I should leave that to the management.

13446. Would you make any general direction?—I should have two zones for every district—that is, one in the intake and one in the return.

13447. And you would leave it to the manager as to where that should be done?—Distinctly.

13448. (*Mr. Wm. Abraham.*) You have been of opinion for a long time that it was possible to prevent the expansion of explosions in mines?—I have.

13449. Compared to your collieries, generally speaking, do you know of any other colliery in South Wales where the physical conditions create more difficulties for the working of coal?—No.

13450. Do you know of any other collieries in South Wales that have more miles of pipes for watering purposes than yours?—No, I do not know of any—that is, for the area opened.

13451. Yours is also among the older collieries. It is, I should say, one of the oldest collieries in our valley?—That is so; there are only two older, I think.

13452. When did you have an explosion?—Never; and I hope we never shall.

13453. Then it is possible, with great precautions, not to have an explosion?—That is so; but I do not feel certain that we may not have one even to-night. That is the feeling I have. I do not yet feel free or safe.

13454. I will not admit that you have been fortunate?—No, I do not want you to admit that.

13455. But it is a fact that in your colliery, which is one of the oldest collieries in the valley—of course, I know there are three collieries altogether—and one of the most extensive in the valley, and one of the most difficult in its physical conditions in the valley, you have gone for 30 years at least without an explosion?—37 years.

13456. And, notwithstanding your difficulties, you have found it possible to build arches in every district in your colliery?—Yes, but we have had to renew them occasionally.

13457. But you have been able to do it?—Certainly.

13458. And to that fact, you and some others that you know—myself among them—attribute the fact that you have had no explosions. I wish to bring out the point as to the possibility in such a colliery as yours of going for 37 years without an explosion?—Well, I have always had vividly before me the danger of dust when others did not admit such a danger, as you know, and I have always tried to prevent it. Whether that has done anything towards not having an explosion, I do not know. But I say, and I emphasize what I have said, that I do not feel easy yet.

13459. I gather that you favour a wet zone as against a dry zone?—Most distinctly; and I act on that view.

13460. (*Chairman.*) In the first Paragraph of your statement you say that you have known mines of only 100 yards in depth which at some parts contained dust highly dangerous. Why is it highly dangerous; is it owing to the amount of it?—Owing to the fineness and the amount.

13461. I thought it was very unusual to have a large amount of dust owing to the ventilation required in shallow mines?—Oh, there is good ventilation. Of course, the hills above add to the depth. There would at that point be 300 yards depth in all.

13462. You mean going straight up?—Yes, but it is not the same as overlying the whole depth of it.

13463. In the second Paragraph of your statement you speak about the comparative explosiveness of coal dust. So far as I can judge from your evidence, the only test that you have of coal dust being explosive is its fineness?—Yes.

13464. There is no test as regards its chemical constituents?—There is a test as regards the structure of the coal. I say that from coal which has a cubical fracture it is very difficult to get dust which will explode easily—such as the Scotch coal, or the Durham coal, or the Northumberand coal.

13465. What do you attribute that to?—Because it still retains the cubical shape. Ours being conchoidal in form, it goes to a powder; but most Scotch and English coals still retain the cube, however small it is.

13466. You mean that dust will not go into such absolute small parts as the other?—No, it does not fly about; it is not part of the air like our dust. On the other hand, I have seen deep pits—for instance, one of our pits in Midlothian, 550 yards deep—where it is naturally wet, whereas with us it would be absolutely dry.

13467. You say, in Paragraph 2, that you have known a blown-out shot of black powder set fire to coal dust?—Yes.

13468. But you have never known a permitted explosive do so?—No.

13469. Do you consider that if you only blast with permitted explosives all danger of explosion, if the shot is properly tamped, is done away with?—Yes, but I should explain that further. At this place the shot was fired 27 years ago; I would not fire a shot of any kind where this black powder shot was fired then.

13470. You think that even if you had not fired this shot with black powder, but had fired it with a permitted explosive, still the same result might have occurred?—No, I do not say so, but I say I would not fire a shot there with any kind of explosive—with my extra experience gained since then.

13471. You are not prepared to say from your experience that even permitted explosives under certain circumstances would be absolutely safe?—I am not prepared to say, but I think they would.

13472. You think they would be safe?—Yes, but I am not prepared to experiment.

13473. In Paragraph 3 you say that explosive dust is found in all parts of the mine, but in different degrees. Then you go on to say that of course the main haulage roads would contain the most dangerous dust. Do you mean on the floor, or on the roof and sides?—Everywhere.

13474. But on the floor the dust would be to some extent polluted on the main haulage roads, would it not?—Yes, on those main haulage roads that were watered.

13475. I do not mean main haulage roads which were watered, but by reason of horses treading, and so on, the ordinary dust from the road would be knocked up and mixed with the coal dust, and the dust would be less explosive, I should have thought?—Yes, but on an arched way there is no other dust to mix with it except a little rubbish which might fall from the trams.

13476. But then, as I understand, the floor would contain particles of dust not so fine as the dust on the timbers-

Digitized by Google

it would not be quite so fine ?—No, it would not be so fine as on the timbers.

13477. Then you would say that the dust on the timbers above the floor would be, on the whole, more explosive than the dust on the floor ?—Yes. There would not be a great deal of difference between them, but on the whole it would be finer. The finest dust of all I should say is at the double parting at the bottom of the pit, because there is more traffic in men and horses, and the air has more drying power there, because it is heated up quickly, especially in winter. That is why I use some steam jets at the top of my downcast in winter.

13478. So that you say on certain parts of the road where roadways meet you would have more explosive dust on the floor than you would on the sides ?—Yes; within 300 yards of the pit bottom very often you have a rise in temperature of 19 deg. or 20 deg. under ordinary circumstances. There we invariably water with a hose, because it cannot be done with sprays.

13479. With regard to the efficacy of watering the floor only, I suppose you would say by watering the floor only you diminish the amount of dust all over the roads—not only on the floor but on the roof and sides—and that there would be a certain amount of dust which, if the floor was not watered, would rise up in the air, owing to the amount of ventilation, and would settle on the timber ?—Undoubtedly.

13480. So that by watering the floor alone you would to some extent not only diminish the dust or take it away altogether from the floor, but you would diminish it above ?—Yes, no doubt.

13481. With regard to this level loading you say, as we have heard, that in South Wales it is the custom to load a few inches above the top of the trams ?—A good many inches—1 ft. to 2 ft.

13482. But you think that custom could be effectively dealt with by spraying the trams ?—Certainly.

13483. You think that is all that would be necessary, and that it would not be necessary to have trams higher up and only to load level with the sides ?—Well, it would be no use unless you could hermetically seal the tram like a watch.

13484. But, surely, if you only loaded the coal up level to the sides there would not be so much dust ?—There would not be so much, but what you did get would be finer.

13485. So that at all events you say it is very important to spray the trams and to spray them not only once, but two or three times on their journey ?—Yes; twice as a rule is enough, unless there is a special reason as I have indicated.

13486. You go on to say that to spray them three times would be superfluous were it not that you want to obviate the possibility of any dust getting on to the electric haulage machinery. Where you have electric haulage apparently you think it desirable to be more careful in regard to spraying the coal ?—There is nothing in that point except to keep dust from the resistance coils and bearings; everyone knows that where you get less dust you use less oil.

13487. You do not mean that it is more dangerous ?—No.

13488. Then you say that you do not advocate complete watering and that you do not think it necessary, and that the floors of many collieries would not stand it. What would you do with main roads supposing the main roads could not stand it ? How would you treat the main roads ?—I know of no other method of treating them. But I think most main roads could stand it if they were very carefully watered, that is to say, water the surface of the dust and do not let it penetrate; but it is, of course, very difficult to do it.

13489. But the only way of dealing with main roads where the floor would heave very much by watering would be to take care not to put too much water ?—Yes. Then sprays would have to be abolished.

13490. How would you do it ?—With hose or a tank.

13491. At all events with your main roads where it is done you have not any very great difficulty in doing it ?—That is so, but our main roads, as a rule, are not in the coal, because our seams are so undulating that the roads have always been made anew, so that we are not comparable with other collieries.

13492. Therefore, you have no experience of main roads where there is any great difficulty in watering the floor ?—Yes, I have. In some of my inside headings I cannot water except very rarely.

13493. Then you must keep them more or less dry ?—Yes.

13494. You say "In the mines under my charge it can be done on the main roads and is done." That is complete watering ?—Yes. When I say "main roads," I mean main haulage roads; I do not mean main headings in-bye. We do water main headings in-bye, but not so thoroughly as we water the main haulage roads.

13495. And sometimes you have great difficulty in watering the main haulage roads ?—Yes.

13496. In your mines you have no great difficulty, although there may be difficulty in some mines ?—Yes, we have difficulty, and it costs us over 3d. per ton to do it.

13497. Have you any difficulty in regard to the heave of the main roads ?—Yes, we have, constantly. We have to cut extra bottom due to the watering.

13498. And you are very careful not to water more than is necessary ?—Well, we try not to.

13499. You said that where it would be difficult in any other way to have an archway that would stand pressure, you could make an archway road by leaving a pillar of coal ?—Yes, a big pillar of coal.

13500. And sometimes you have had to do that ?—We cannot do it.

13501. But you suggest that as a means of getting over the difficulty ?—That is the only means. But if that were adopted—if we were compelled to do that—it would close our colliery, for the simple reason that we must have output to cover our general charges.

13502. So that you would say it might be possible in some collieries to get over the difficulty of arching where the ground is very difficult, and where it is difficult to put the arches, by leaving a very large pillar of coal ?—Yes.

13503. But that in your colliery it would be impossible to do that ?—Yes, and in most collieries it would prohibit their working to the full extent.

13504. You go on to say that the partial watering of mines under certain circumstances would, in your opinion, prevent the spreading of an explosion. What do you mean by "certain circumstances"—what circumstances ?—Those I have already given—that is, arching.

13505. That is to say, that if you have an arched roadway it would be sufficient to make a floor fairly damp ?—Yes. You could then water the whole area of the roadway.

13506. Then you water the arch and all ?—The arch and all, and all its area.

13507. Where you have an arch you would deal with it by watering, and you would not deal with it by sweeping ?—I do not think you could sweep a roadway clear of dust; I think it is a physical impossibility.

13508. Supposing you had an arched roadway, say 200 yards long, and could sweep it perfectly clean from dust, do you think that would stop an explosion or not ?—It would not stop it so effectually as if that area were watered.

13509. And you have your doubts, perhaps, as to whether it would be stopped at all ?—I have grave doubts about it.

13510. Then you say that the use of salt and non-inflammable dust or material is impracticable. We had some evidence to show that the use of salt is valuable when put on the floor of a mine which will not stand watering very well ?—I did not notice that in the evidence. I have not heard of a case where it was valuable.

13511. You have not heard of any case where it has done any good ?—I have not.

13512. You have heard of its being tried, I suppose ?—I have heard of its being tried for many years.

13513. But you have not heard from anybody that it has done any good ?—No.

13514. (*Mr. Cunynghame.*) Would there be any objection to our having the figures as to the 1¾d. per ton ?—None whatever.

13515. You can give them in sufficient details to enable us to see how it is made up ?—Yes, I can give you the details of it.

13516. Have you those details there ?—No, I have not.

Digitized by Google

Mr. W. W Hood.

20 Feb. 1907.

I think it is 1·73d., or something like that. I cannot remember exactly.*

13517. We want to be able to see how much the different items cost?—Quite so; you mean on the German lines.

13518. Yes, in comparison with the German method?—I can give you that information.

13519. The other figure, the remaining 3¼d., is much more difficult to estimate?—It is much more difficult.

13520. And it depends a great deal upon the particular mine?—Yes, and it depends upon the opinion of the manager.

13521. I suppose if you had any reasonable system of watering it would not apply to all the mines in the country, by any means?—Oh, no.

13522. There would be a large number naturally wet?—Yes, a very large number.

13523. And a number that would not require watering, because they were not dusty?—That is so; and a large number that would not stand it if they were dry.

13524. That is to say in which you would absolutely ruin the mine if you attempted to do it?—Yes, cases in which you would absolutely ruin the mine if you attempted to do it.

13525. Then if you merely moisten you could not do it?—No, you could not do it.

13526. I do not know whether you could give us an idea of how many mines it would be reasonable to water in throughout England, or even in your own district. Of course it is a matter with regard to which one could only make a rude guess, but could you give us a notion?—No, I would not say, because I could not give it near enough.

13527. It is rather necessary for us to have some idea of that in our minds?—Yes.

13528. For instance, would it be half of the 3,000 mines in the Kingdom? You see my mind is quite open upon the subject?—I should not think there would be anything like the proportion of half the mines in the Kingdom that would require watering. I do not think so.

13529. Then another question would be this: In a certain number of mines watering would be impossible?—That is so.

13530. Those would not be a very large number, I suppose?—No, but in parts of mines like our own in South Wales, for instance, it would be impossible.

13531. What could you do in those cases?—I suppose there is nothing you could do, is there?—There is nothing you could do except on the zone principle.

13532. You could water by zones?—By the zone principle you water the most dangerous part. The faces are not the most dangerous part.

13533. When you say that it is impossible you do not mean that zone watering is impossible. That is always practicable?—That is always practicable—if you can put arches.

13534. Yes, if a mine is not too deep to put arches?—That is so.

13535. But supposing you cannot put arches; still, by the use of iron girders or steel girders, you could do it?—Yes. That is what I substitute where I cannot put arches, but they are not so good as arches.

13536. Have you any idea of the length of zone necessary?—As I say, that would depend entirely upon the area of the road and the quantity of air passing through it.

13537. But have you any idea of the length of road that would stop an explosion?—Yes, I have seen 50 yards stop an explosion, but I should like to have not less than 150 yards myself for the big quantity of air that we have to deal with. As a matter of precaution what I like to do is to deal with the whole road where I can.

13538. Can you give us any information as to a practical method in which some proposal to water mines could be brought into force? I should like to explain my question. You say it depends in most mines upon circumstances; what may be possible in one mine is not possible in another: and in some mines it is not necessary. Can you outline any idea of a scheme by which watering could be brought in by law, which would be the least disadvantageous to masters and men, and the most easy?—I think the zone method would be the best.

13539. You think it would be sufficient to insist upon zone watering in certain cases?—Yes, I think so.

13540. In case of dispute how would you propose that it should be settled; supposing an inspector thought watering was necessary and the owner did not see his way to do it?—By the usual arbitration, I should say, the same as other disputes between owners and inspectors are settled.

13541. Then, according to your view, you could not have a universal rule applicable to all mines?—No, I think it would be impossible.

13542. You must treat each mine to some extent, at all events, on its own footing?—Yes, I think so.

13543. But do you not think you could name a few general principles which ought to be enforced unless the owner showed—and it should be upon him affirmatively to show—that it was impossible, or impracticable, or inexpedient. For instance, could you not say that every dry and dusty mine should have a zone of at least 100 yards, and that no length of road in the mine greater than a certain number of yards should be without a zone?—Yes, but who is to choose the zone? If the manager is to choose the zone I should say so.

13544. Allowing the manager to choose the zone, but forbidding greater length than a certain limit of zoneless area or zoneless road?—Yes, quite so. But supposing an inspector was coming to me and saying "You must make the zone here," and I said "If I make such a zone there as I have on the main road the place will be down by the morning," and he said "No, it will not," I must retain my idea of the mine, because I am supposed to know more about it than anybody else; and I could show you parts of my mine which, if I watered them to-night in the same way as I water on main roads, they would be closed in the morning.

13545. And you would know that, or you would claim to know that, better than anybody else—you and your managers between you?—Yes. I may tell you that by universal watering years ago I ruined a whole district. The only method by which a dry and dusty mine can be effectively watered is to raise the temperature of the intake air by steam jets above the temperature of the surrounding strata, then the moisture will be given out from the saturated air on its passage through the workings by reason of the temperature being gradually lowered. This is what I tried, and ruined the district for a time. Besides, in a hot and moist atmosphere, neither men nor horses can work.

13546. (*Mr. Ratcliffe Ellis.*) You did it under the most favourable conditions?—I did it under the most favourable conditions, and I turned the conditions of a dry and dusty mine into the same conditions as prevail in a shallow mine; that is to say, take a July day, for instance: you start with a temperature on the surface of 70 deg. and get down to 60 deg., or you gradually reduce that temperature until you come to the upcast temperature, and it deposits the moisture. I refer to a saturated day when the two bulbs were exactly the same. I turned that air into the steam coal or deep measures, and that gave me a temperature of 84 deg. at the bottom of the downcast, the temperature of our strata being somewhere about 78 deg., so that the atmosphere dropped in temperature all the way round the faces—the faces were a little over a mile in-bye round to the return—still depositing moisture, because if you start with a hot saturated atmosphere and cool the area you deposit the moisture; and that is what you want to do to make a steam coal colliery absolutely safe. But in a week's time it brought the whole of the roads in, and I never saw such a mess as it made of the district. Besides, you create a temperature in that state of things in which the men cannot work.

---

* Mr. Hood subsequently sent the following statement, showing the actual cost of underground watering for 1906 at Nos. 1, 2, and 6 Steam Coal Pits, Llwynypia:—

Fixing and repairing pipes, and manipulating jet and hose. Twenty-six men at 5s. per day per annum	£2,028	0	0
Cost of Material, flanges, bolts, &c., &c.	1,650	0	0
Taps, hose, tanks, &c.	545	0	0
Cost of hauling water in tanks	1,872	0	0
	£6,095	0	0

Equivalent to 1·72 of a penny per ton.

Digitized by Google

13547. (*Dr. Haldane.*) You got it at 84 deg. wet bulb?—85 deg. wet and dry.

13548. As much as 85 deg. wet bulb?—But there are collieries in Belgium working in an atmosphere of 100 deg.

13549. Yes, but not wet bulb?—No. Of course, if you go above 70 deg. or even 65 deg. wet and dry you cannot do good work.

13550. (*Mr. Cunynghame.*) Supposing you take such a dry and dusty mine as there ought to be some watering in, would it be oppressive or unworkable if no length of road greater than a certain amount existed without a wet zone of some sort?—I think that would be quite reasonable so long as the manager was allowed to select that part.

13551. Yes, give him *carte blanche* to put his wet zone where he liked, subject to this condition, that there should be no length of road greater than a certain length that did not somehow come in contact with the wet zone?—That is so.

13552. And that should be done in dry and dusty mines, and it should be subject always to the possibility of an owner showing that it was impracticable or inexpedient for some special reasons?—Yes, that would be quite reasonable.

13553. Well, I meant necessarily that it would be, but I wanted to get something in the nature of a practicable proposal from you?—Yes.

13554. I understand the use of salt has been tried. I suppose glucose or sugar or anything of that sort has never been tried. Glucose is cheaper than salt a great deal. Would that not possibly mat the dust in the same way that these preparations are used for the purpose of laying dust on roads so as to mat down the dust and let it remain a matted mass which, if it was done from time to time, would stick?—But a road in a pit is not the same as a road on the surface.

13555. I was rather alluding to the sides?—The same thing applies, because however much watering you have you cannot keep that crust free from dust.

13556. But my notion was that you could make it perpetually wet and sticky—the same idea as the use of salt?—It would have to take up moisture which it could not get, because you cannot get it from the air, and if you have a cold day on the surface, that is to say, the temperature at 32 deg., it is quite impossible to saturate it.

13557. If you could cover the walls and sides with glycerine, I suppose that would be wholly effective?—But the air would take up the moisture from the glycerine.

13558. I should think it would not take it up from the glycerine, but I will leave that to Dr. Haldane. At all events, nothing of the sort appears to have been tried. I do not know whether it is practicable?—I do not think it is practicable.

13559. (*Dr. Haldane.*) I do not know whether you have studied the effects of watering in the German districts where watering is practised on a large scale?—I have not been underground in Westphalia for that purpose. I have noticed them, but I did not go with that object; I had other objects. Of course I always notice watering in a general way wherever I go.

13560. So far as we were able to make out, they had had comparatively little difficulty there with watering as regards roof and sides?—I should think that would be so.

13561. Can you give me any reasons why they should not have difficulty?—Yes; because the roof and sides are totally different from ours, and they have not got the pressure on them either.

13562. Most of the Westphalian big mines are at considerable depths?—Yes, and they are heavily inclined; that favours watering.

13563. That is very important; you think that favours watering?—Yes, distinctly.

13564. In what way?—Because you do not get pools of water about the roads, and you do not have the water saturated into the pavement or bottom, and the water goes off the roof, too.

13565. Their main roads are cross measure drifts?—Yes.

13566. You would say there would not be much danger from watering there?—Absolutely none, any more than there is in a similar stone drift in our place. We have a heading crossing the measures for 520 yards; that is always a puddle—there you have no difficulty in such roads.

13567. You may water as much as you like in it?—Yes, you can have it knee deep if you like there. The same conditions as are usual in Germany are unusual with us; and the same remark applies to Belgium and most parts of France.

13568. Is there much watering done in Belgium?—Yes, a good deal, but their main roads are all in the cross measures; they are not in the seams that go up and down; and they have in no district the quantities of gas that we have—I mean per square yard or square foot of face they have not as much gas given off as we have, although people generally think that in Belgium they have more, for the simple reason that they cannot get large quantities of air through their thin seams; you cannot get a great quantity of air through an 11-in. seam. Therefore there is often a cap on a safety lamp such as I would not like to work with.

13569. Then even when the roads in the Westphalian mines run in the seam itself—I mean those inclines and levels which they have in the seam itself—you would say that the inclination of the seam favours watering?—Yes, and the roof and the coal. The coal has a cubical fracture. If you take Hibernia, or any of the collieries in that group, and perhaps in Midlothian, they are exactly the same; also the Niddrie Collieries in Scotland. So that the comparison is not fair, in my opinion. I am comparing them now with pits of the same depth and the same conditions as regards inclination and otherwise.

13570. You think that with fairly level main roads, originally made in a seam, there will be much more difficulty in watering?—Yes, that is where you will get the difficulty. Where you get a level heading in Belgium following the seam and on the pavement of the coal you cannot water it to the same extent as you can in the cross-measure drifts. Possibly you noticed that as I did; it will simply heave up the pavement.

13571. That is a very important point. I have heard no complaints about the effect of watering on the timbers in Germany?—The effect is very good. I would water the timbers if I could; they will last so much longer.

13572. We have had a variety of evidence on that point?—I would water them with salt water, too.

13573. (*Chairman.*) You think salt water makes them last longer, and not fresh water?—Salt water will make them last longer than fresh water. If you keep watering the timbers dry rot will not get into them.

13574. (*Mr. Haldane.*) But several witnesses have objected to watering on the ground that it would destroy the timbers?—I think the opposite; indeed, I am sure of it.

13575. Do you not think it is possible that if you alternately water them and then let them dry they would deteriorate?—Then the timber would wear out quicker than if it was either dry or wet—you cannot do it at intervals and preserve the timber. But I say if you keep the timbers wet continuously they will last longer than if they are kept continuously dry; but if you water them to-day and let them dry next week you will make them rot quicker.

13576. In your collieries where the floor is kept watered you think there is still a certain amount of dust getting on to the timbers?—Yes, there is some. But then I say a little of that fine dust goes a long way.

13577. You would not, therefore, feel at all safe with watering confined only to the floor?—No, although it does a great deal of good. I would not be certain of it, but it does a great deal of good; and if you water the trams and the floor you can follow a journey going at seven miles an hour against a strong air current through a comparatively small way, without your eyes being affected at all.

13578. So that most of the dust is raised by the journey from the floor?—Yes, and by the journey itself—by the coal on the trams. You must water the trams and you must water the road.

13579. You think it is quite essential to water the coal on the trams?—If I had my choice between the two I would water the trams rather than the road; because, if you water the trams you will not get the dust on the roads.

13580. In some districts there is a serious objection to watering the trams?—Yes, it may be, because it may crumble the coal.

13581. I mean there is some coal that heats easily?—Then it must be coal which is naturally damp and which would not require watering.

13582. No, there is some coal which, when it is watered, heats very easily?—But what I am referring to is only a spray at the tail end, which, it is true, is under 500 lbs.

Digitized by Google

Mr. W. W. Hood.

20 Feb. 1907.

pressure, and the journey is passing, say, at four miles an hour, and it just wets it—that is all.

13583. It does not do any harm at all to the coal?—There is no harm whatever done to the coal. There is less dust when it is screened.

13584. With regard to the effect on the atmosphere of watering, you say that a hot, saturated atmosphere would be very uncomfortable to work in; but would it not be the case that with watering in the main road you would cool the air very much?—Yes, you would cool it, no doubt.

13585. I mean, you do not put that forward as a very serious objection to watering?—I do not say it is an objection to watering at all, so long as the temperature is rising, because it is always below dew point.

13586. You never get the air saturated?—Once I think I got it saturated under these conditions: I started at 93 per cent. of saturation—that was about 500 yards from the pit bottom; and then I got it at dew point all the way round, 500 yards from the bottom of the downcast, when it was raining heavily at the surface. The surface temperature was 50 degs. I got the dew point 500 yards from the bottom of the downcast and maintained it throughout all the workings except in the faces, and there it does not matter, because the men are working there and you want it below the dew point. In hard frost it was quite impossible to get it up to saturation point.

13587. Was that by watering or by steam?—By sprays.

13588. Did you observe what fall of temperature accompanied the spraying there?—The temperature rose at the bottom of the downcast to 69½ degs. dry bulb and 69½ degs. wet bulb.

13589. What would have been the temperature at the bottom of the downcast without the spraying?—The bottom of the upcast without the sprays, you mean.

13590. No, the bottom of the downcast. You have just given me the bottom of the downcast.—No, I have given you the bottom of the upcast, 69½ degs., that is dew point. There was only 93 per cent. of humidity in the bottom of the downcast on that day.

13591. Were you watering the returns?—We were watering the returns and all—the whole system.

13592. Do you know what was the temperature at the bottom of the upcast without the watering in the spray?—The bottom of the upcast on a similar day?

13593. On any day it would be the same?—73 degs. dry bulb and 68 degs. wet—5 degs. difference between them; 74 per cent. of humidity.

13594. So that the temperature had gone down several degrees?—The temperature had gone up.

13595. No, surely not?—Yes, the temperature had gone up.

13596. You said that without spraying there was a temperature of 73 degs. at the bottom of the upcast, did you not?—Yes, the dry bulb 73 degs. and the wet bulb 68 degs.

13597. Then with spraying the temperature had fallen?—With spraying the temperature of the dry bulb was 69½ degs., and of the wet bulb 69½ degs.

13598. So that the actual temperature had fallen several degrees?—Yes, the actual temperature had fallen, but that might be due to other circumstances, although I do not understand it.

13599. Why should it not; I think it is very natural that it should fall?—Yes, you are perfectly right. Of course, watering must reduce the temperature. It does reduce the temperature.

13600. Particularly if the air is very hot; I mean the evaporation will absorb an enormous amount of heat?—Yes.

13601. You say there is less danger of an explosion at the face; you think that applies even to Welsh collieries?—Well, I have never found the force of the explosion along the faces nearly so great as in other parts; it is generally a gentle sweep along the face.

13602. Still, explosions do pass along the face?—Yes, no doubt; and I have cut off cakes of coal dust three-quarters of an inch thick at the faces; but you never get so much force at the face. Generally at the face the men have had a little warning.

13603. Before the explosion gets there?—Yes, showing that it did not originate there.

13604. But surely in many Welsh mine explosions the explosion has originated at the face, so far as it was possible to tell?—Yes, but the origination does not mean force.

13605. But it is enough to kill all the men?—No doubt. I do not say it has not done so, but I say the dust at the face is less dangerous than in the main road, where there is a lot of travelling.

13606. I suppose you would say that in most other parts of England the face is almost immune from explosions?—I have never had an opportunity of going down an English pit after an explosion; my experience is entirely confined to South Wales after explosions.

13607. But I think from the records that is so; the explosion usually stops before it reaches the face in the North of England—Yorkshire, for instance?—Yes, perhaps so. Of course, a lot of the miners in South Wales are killed by carbonic oxide and carbon-dioxide, as well as by burns.

13608. (*Mr. Smillie.*) I should like to emphasize the point with regard to the watering of timber. Has it been your experience that in a mine naturally wet, with water continuously coming from the roof and keeping the timbers wet, the timbers stand considerably longer than they do in a mine which is absolutely dry?—Distinctly so. I can give you an example now of what I saw yesterday. I am opening a place that has been drowned out for 45 years, and the timber is not bad at all.

13609. Where the roof and timbers are wet?—Yes, where the timbers are saturated they will last a long while, provided you have not got pressure on them.

13610. (*Dr. Haldane.*) They have been kept constantly wet there?—They have been kept constantly wet.

13611. (*Mr. Smillie.*) Thorough watering of a mine—the sides, roof and pavement—would keep timbers wet if they were thoroughly watered?—Yes, but not so wet as they would be in a naturally damp colliery.

13612. Quite so; but even in that condition, if they were not allowed to dry, they would stand longer than if they were absolutely dry?—Certainly; but it would have to be kept on continually.

13613. Do you remember whether the timbers in the Clydach Vale explosion for the 700 yards, the crowns and side timbers, were blown out?—Not one was blown out.

13614. Not one?—Well, I can hardly say that. For the first 100 yards—I am talking of where we blocked off the fire, which was 300 yards from the pit—perhaps for the first 100 yards there were two or three pairs of timbers blown down, but the whole lot were close together, and after that there was not one blown out, and we were not impeded at all; we simply walked straight on until we got to the first batch of corpses at the lamp station.

13615. Was there some place where the force of the explosion could have got up to the timbers?—No, I do not think so; it just rolled along.

13616. Then how could it communicate to the dust in the vacant space at the top of the timbers?—The dust communicated with it.

13617. It came down through the timbers?—It came down through the timbers. I went there and spent hours myself and I scraped pieces of dust off the timbers and examined them through a microscope, so that I was able to see the globules of half-baked coal dust.

13618. But you did not satisfy yourself as to whether there was an accumulation of gas in addition to dust on the top of those timbers?—I have no doubt there was an accumulation of gas in addition to dust, but I think the timbers were too close to allow it to accumulate much, and I have no doubt it was helped on by a puff of gas here and there.

13619. Of course there would not be sufficient gas to get to this air at any time so as to raise it to an explosive point?—No, I do not think there could be.

13620. What class of Scotch coal do you refer to when you say with regard to the Scotch coal and the North of England coal generally, because of the nature of the fracture, the dust is not explosive?—Because it is always a cubical fracture.

13621. Do you refer to all classes of Scotch coal?—Yes, all that I have seen; and I refer to dry and dusty mines in Scotland, such as Blantyre.

13622. Then do you consider that the Blantyre and Udston explosions, which were very extensive explosions —— ?—I do not know as to the Udston explosion. I know Bent and several of those places.

13623. You had no personal experience of the Dixon explosion, of course?—No.

13624. It is too long ago?—Yes.

13625. Have you heard of it?—Yes.

Digitized by Google

13626. Do you know whether or not it was a gas explosion continued or fed by dust?—I do not know. But I do not think that dust such as I have seen there would carry an explosion nearly so well as ours.

13627. You are aware that Dixon's explosion, or what is called the Blantyre explosion, spread through three different pits?—Yes.

13628. And that it broke down the trap-doors between three different pits?—Yes.

13629. There either must have been an enormous accumulation of gas or else dust did play a part in it?—Yes, and I think dust must have played a greater part than gas to carry it that distance.

13630. Do you know any of the Stirlingshire coals?—No, I am not acquainted with Stirlingshire of late years.

13631. You do not know whether those coals are pretty much in the nature of the South Wales coal?—I could not say.

13632. In some cases you do leave barriers in South Wales under railways or under waterways or between two different land-owner's ground, do you not?—No, not under railways but on boundaries.

13633. In some parts of the country you know it is done?—Yes, I know that is so with regard to barriers. Railway companies refuse to buy coals under the bridges or under the railways with us. I know of one instance of a tunnel having been brought down by mining, namely, the Cockett Tunnel, because the Railway company would not buy the coal.

13634. The reason why I put this question is because you said that if you were forced to do a thing of that kind you would require to shut down your collieries, because you need to keep up your output?—Yes.

13635. Would it necessarily mean the shutting down of your collieries if you deliberately left 60 or 80 yards width of collieries on your main roadway in order that you might be able to arch it?—60 or 80 yards would not do, to begin with; it would need to be 120 yards, and that would have to be twice, with your return, and it would mean breaking up the faces—and continuity of faces is essential in Welsh mining. In the example which you give of railways, they would pay us for the coal. If somebody gave me half-a-crown per ton or anything like that figure for my coal I would shut up the whole colliery to-morrow.

13636. It would be a question of cost, no doubt?—Yes, it would. It is a question of cost whether you keep going or not.

13637. I take it you have as much practical experience as most people in regard to this question. You have had a long and continuous experience of it?—That is so.

13638. Do you think that arching 400 or 500 yards from the coal face can be done? It may be expensive, but it can be done, can it not?—We cannot get nearer the coal face than 250 yards with arches under the best conditions. that is to say, if you put an arch to-day, this day fortnight or this day month it will be down. You must let the ground settle. Even sand or ashes behind it will not do it.

13639. I want to test it, if possible. Your working is all longwall?—It is all longwall.

13640. Do you find it is fairly well settled when you get 400 yards back, generally?—Yes, fairly well.

13641. And taking it for granted that you are not working seams underneath that, you think that would be in a general case sufficiently well settled to arch?—We have always been able to arch under those circumstances.

13642. Have you always been able to renew the arches under those circumstances where you did not work a seam underneath?—Occasionally, but I have often had it put in with plenty of soft backing and with bricks as against stone.

13643. You think in ordinary cases it would be possible in most of the mines in South Wales to arch that distance back from the face?—I have always been able to do it.

13644. You think that, where the roof is so bad that watering would be practically an impossibility, arching might be resorted to?—Yes.

13645. You point out (in Paragraph 7) that the use of salt and non-inflammable dust or material is impracticable. Might I take it that the mixing of the fine dust which gathers in the sides and timbers with a certain percentage of some other non-inflammable or non-explosive material would prevent this fine dust exploding?—Not unless you damped it.

13646. You think that if it was mixed with fine dry material it would be explosive?—May I give you an example which I think might answer your question: I have seen a heading of 130 yards long at Penygraig, where an explosion happened on the 10th December, 1880, and there was nothing that you could see but stone dust with a little coal dust when it was examined under the microscope, and the explosion went through that heading: it was a big mixture. I think Mr. Galloway was with me when we took that dust, and I think he could bear me out in that.

13647. (*Chairman.*) Does it not depend on the fineness of the dust. Perhaps very fine dust from any mine is explosive?—Yes; that was the question which we were considering—whether coal dust containing little or no carbonaceous matter would explode.

13648. If it was fine enough?—Yes.

13649. But supposing you had dust which was very fine, say, such as sand?—Then the first little blast would blow the one away from the other.

13650. (*Mr. Smillie.*) You think the fine coal dust would explode independently of any other mixture?—Yes.

13651. It has been said by some witnesses of long experience and great theoretical knowledge that the dust on the pavement, although it contains a considerable percentage of very fine coal dust, being mixed with fireclay and other things from the feet of the horses and so on, is non-explosive?—No; but is not fireclay in the usual acceptance of the term always damp?

13652. It has been put by the witnesses here that no matter how dry it is, coal dust under those circumstances with, say, 40, 50 or 60 per cent. of other matter in it, no matter how fine it is, would not explode if those were mixed together?—I do not know. It is not my experience.

13653. But you have found in some cases where there was a small percentage of fine coal dust that it really did explode?—The explosion went through that heading: it was the only way it could go. The two pits were about three-quarters of a mile away from each other, so that it was the only way it could go through.

13654. I have put a suggestion to some witnesses, and I should like to hear your opinion of it: you know the sand blast which is used now for cleaning stone buildings, by which the sand is blown out through the sand blast?—Yes.

13655. Would there be any hope of any process of that kind being used for the purpose of applying it to the top of the wood where you cannot get at it with water, and cleaning it down—having a sand blast going along the top of the timbers and cleaning the fine dust off?—But where would that fine dust land again? It would land about 10 or 20 yards further on, on timbers again.

13656. Would it not mix with the sand and fall to the ground, most of it?—If the sand were damp no doubt it would.

13657. Would it be possible to have a sand blast with sand that was partially damp?—Taking our miles of roads I do not see how it could be done.

13658. Small quantities of sand would be sufficient?—Yes, I know; but small quantities of sand to do a road, say, 2,500 yards long, would take up that road for the whole of its length, because, if one part of it is taken up, of course it is useless for anything else.

13659. It could be done in the night-time, of course?—But our roads are as busy during the night as in the day. I do not see that it is practicable, and I do not see the efficacy of it at the present moment. But that is, of course, without thinking the matter out. I know the things which you refer to for cleaning buildings.

13660. The difficulty of sweeping the dust off with a broom was pointed out, and some witnesses have said that they effectively sweep all the dust off all the places they can get at with a broom, but that there are some parts they cannot get at, and the dust is in those crevices?—Yes.

13661. I am suggesting that the dust might be blown out of those crevices by this method?—Yes—or mixed with a non-inflammable substance.

13662. You have not thought about that?—I have not.

Digitized by Google

TWENTY-FIRST DAY.

Thursday, 21st February, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

H. H. S. CUNYNGHAME, Esq., C.B.
WM. ABRAHAM, Esq., M.P. (Rhondda).
ENOCH EDWARDS, Esq., M.P.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. JOHN T. TODD, called and examined.

Mr. J. T. Todd.
21 Feb. 1907.

The Witness handed in the following Statement:—

13662A. I am General Manager of the Blackwell Colliery Co., Ltd., a member of the Midland and North of England Institutes of Mining and Mechanical Engineers, a Vice-President of the National Association of Colliery Managers, Vice-Chairman of the Nottingham and Derbyshire Coalowners' Association, and a member of the Executive of the Mining Association of Great Britain. I have held a first-class certificate since February, 1879 (Newcastle-on-Tyne). My experience has been in Durham, at the Hetton Collieries, Messrs. Pease & Partners' Auckland Collieries, and during the last 10½ years in Derbyshire and Notts.

The number of pits on this property is eight, varying from dry and dusty to thoroughly wet. Output about 1½ million tons per year, and employing 3,810 persons.

The number of shots fired in the coal and in gate-ripping last year was 66,611, carbonite being used in every case.

(1) It is exceedingly difficult to classify dusty and non-dusty mines. There are mines which produce a certain class of dust, that with a given quantity of deposit would be much more dangerous than other mines with an even larger deposit. Some mines are very warm and dry; others are very cool, and the air contains a larger quantity of moisture. Some of the dust is fine coal that may be highly inflammable; in other cases the dust is almost entirely grey rock, or bind. It would probably be necessary to have two classes only —dusty and damp throughout—with a provision for exemptions under certain conditions.

(2) The most explosive dust is that produced by coal and shale, or bind, the coal being that crumbling from the sides of the roadways when made in coal, or that shaken or blown from trams, shale or bind falling from roofs or sides, and becoming gradually reduced to a fine mechanical mixture. This, as it is stirred up, is carried with the air, and deposited on sides and roof. It is this fine dust that is liable to ignition.

(3) An explosion can only be produced, in my opinion, by some sudden shock and large volume of flame at a high temperature, which would create a cloud of this dust, and ignite it either with or without gas. I do not agree that an explosion can be caused by a naked light without gas. Many pits are worked with naked lights, and these are constantly used on main haulage roads when in their most dusty condition.

(4) The finest dust is found on main haulage roads.

(5) The dust in working faces is not in my opinion a danger, and cannot be blown from them. It does escape through crevices in trams, or is shaken or blown off.

(6) In this district the screen dust is not a difficulty. A large proportion of our coal is loaded into the trams by hand or by forks with prongs 1¼ in. to 1½ in. apart, and in such seams as the top and deep hard coal there is not much dust shaken out of trams.

(7) I see no object in altering the trams. The mines are all worked on the long-wall system, and the amount of coal dust is small in proportion to that from roof and sides.

(8) Complete watering could not be carried out. Many of the main roads would either be completely ruined, or in a dangerous state; neither would it be practicable to lay down a hard and fast rule with regard to zone watering, for the same reason. If watering is done it must be more than mere moistening, and to go to the full extent would create a danger. If watering is adopted it would be necessary therefore to grant exemptions, and generally these would apply to the most dangerous or dusty mines. In some mines zones could be watered, and in others they could be maintained as free as practicable from dust, but they would not be absolutely dustless at all times. Where roadways are arched this could be more easily carried out, but there are mines where arching cannot be maintained.

(9) I prefer to water with a water barrel, holding from 150 to 200 gallons. Water is forced into the barrel, compressing the air inside, to say 60 lbs. per square inch. This, in turn, forces the water through fine sprays, or hose pipes can be attached. Watering through a line of pipes would be an expensive item in many pits with long lengths of haulage roads.

(10) The quantity of water required may be assumed at 12 to 15 gallons per yard. If a distance of 50 or 100 yards is cleaned and thoroughly swept from dust it would, in some mines, require to be re-swept every few days, but even in 24 hours there would be a fine deposit of dust.

(11) Therefore, for these reasons, I think there must be alternative methods.

(12) The degree of danger has not yet been sufficiently demonstrated. There should be further experiments to ascertain what dusts are dangerous, what are not, and the conditions under which danger arises.

(13) I believe that since the Explosives Order came into operation, no explosion has originated from ignition of coal dust alone, where any permitted explosive now on the list was used, and where the watering, as provided, was carried out. Further, the death rate from explosions is small, and therefore legislation should not be hurried until very full experiments have been carried out.

(14) If the present Order is thoroughly carried out, or amended, I consider that there is not a serious liability to accident. No shot should be fired on a main haulage road except with a permitted explosive of the highest class. Then shots should be fired by a special person appointed in writing by the certificated manager; the charge to be inserted and stemmed by him. This reduces the liability of a blown-out shot, whilst the explosive used would also be specially selected. Watering as provided, would also be carried out and, if necessary, the shot fired when all the ordinary coal getters were out of the mine.

Digitized by Google

(15) In the workings I see no objection to using permitted explosives only in all cases.

(16) Finally, I suggest zones of 100 yards either watered or maintained as clean as possible, and the strengthening of the shot-firing regulations on main haulage roads, and the carrying out of further experiments.

(17) In reference to the German system, much of what I have already stated applies, pipes are no use if they could not be used. The condition of dusty roads may be very different there, and further, there is not the care in selecting the safest blasting agent. In old collieries the cost would be much greater than in a modern colliery where everything is fitted up for a large output. The moisture carried into the workings would be injurious, whilst in collieries subject to spontaneous combustion the danger would be increased.

13663. (*Chairman.*) You are the General Manager of the Blackwell Colliery Company, a member of the Midland and North of England Institutes of Mining and Mechanical Engineers, Vice-President of the National Association of Colliery Managers, and you have other qualifications ?—That is so.

13664. You have held a first-class certificate since February, 1879, and your experience has been in Durham at the Hetton Collieries, Messrs. Pease and Partners' Auckland Collieries, and during the last 10½ years in Derbyshire and Nottinghamshire ?—Yes.

13665. Is that an exhaustive list of your experience, or do you know anything of collieries anywhere else ?—Do you mean whether I have control of collieries anywhere else ?

13666. Yes.—Not except in Derbyshire and Nottinghamshire.

13667. Outside Derbyshire and Nottinghamshire you have had no experience ?—Not lately. I have had experience in Durham and Northumberland in previous years.

13668. You have had experience in Derbyshire, Nottinghamshire, Durham and Northumberland ?—Yes.

13669. With regard to dust you say it is exceedingly difficult to classify dusty and non-dusty mines, and you remark that dust varies to a great extent in regard to the description of the dust. You say some dust is fine coal and is highly inflammable, and in other cases the dust is almost entirely grey rock or bind. With regard to the inflammability of the dust, have you made any experiments with a view to finding out what it is that makes one dust which is just as fine as another more inflammable ?—Yes. I think the experiments which were made by the Chesterfield Mining Institute some years ago proved pretty clearly that the ordinary dust of the Midland district was not explosive in itself.

13670. You mean under conditions that could take place underground. I suppose if you put in a confined space an enormous quantity of dust, more than would be found underground, it would be possible to explode almost any fine coal dust, would it not ?—The Chesterfield experiments were not able to create any explosion by any dust without the presence of gas.

13671. Not even in a confined space ?—Not even in a confined space where they specially tried it.

13672. What do you attribute that to ? Why should the Chesterfield dust be less inflammable than other dusts ? —I think it is probably due to the large mixture of rock or clay dust and to the small mixture of highly-inflammable coal.

13673. I used the word "inflammable," but of course all dust might be inflammable without being explosive—you might get a flame without explosion ?—That is so.

13674. Could you get a flame out of this dust by an ordinary light, or must there be something in the nature of a blown-out shot, or something of that kind to cause a flame at all ?—It had to be in the nature of a blown-out shot. In the Chesterfield experiments it was created by firing from pistols. Perhaps I might read, from the Chesterfield and Derbyshire Institute of Engineers' Transactions, Vol. 10, the conclusion which they came to. It is very brief ?

13675. Certainly.—"The written opinions of members of the Committee have been specially consulted and are occasionally quoted from in drawing up the following remarks:—It is necessary to define the words 'explosion' and 'inflammation.' An 'explosion' is anything which causes a sudden increase of pressure in the surrounding air or gases from the sudden and violent expansion of any substance (gas, liquid or solid) in their neighbourhood. 'Inflammation' is the quiet production of flame unaccompanied by any sudden or violent change of pressure in the surrounding gases. The Committee are unanimously agreed that no explosion took place when gas was not present, but that inflammation or ignition of the dust did occur." I think the ignition was obtained in 36 cases of dust out of 134 experiments that were made, many of them with dust from the North of England.

13676. Then, did you come to any conclusion as to the proportion of admixture of non-inflammable dust that would prevent the fine coal dust being inflammable—the proportion of extraneous matter, non-inflammable dust. You say you think the reason why this coal dust was to a great extent non-inflammable was that it was mixed with a lot of dust from grey rock and other inflammable dust ?—It was dust as it occurs in the mine, collected from timbers just in the ordinary way. Of course, it was not analysed.

13677. So that you do not know what proportion of the dust you collected from the timber was pure coal dust, or what was grey rock, or some other kind of dust ?—No; it was the dust that is actually made in the mine.

13678. Then, naturally, you found that it depended a good deal upon where you got the dust from. The inflammability of the dust did not only depend upon its being fine dust, but depended upon its admixture with other substances, no doubt ?—Partly upon that; and I think the question of the inflammability of the dust depends quite as much on its mechanical character.

13679. What do you mean by "its mechanical character" ?—I think you might get a dust which would not be inflammable or explosive if it was of a certain size, but if ground down to very fine powder it might be.

13680. You mean that the fineness of it has a good deal to do with its being inflammable ?—Yes.

13681. You say that however fine and however pure coal dust might be, still, although some of these specimens were inflammable, none of them were explosive ?—None of them were explosive.

13682. With regard to dust that is inflammable and non-explosive, would that flame be carried on ? Supposing an inflammable dust started a flame in a mine, but not an explosion, I suppose the air current would carry that flame on ?—Yes; I think it is quite possible that once you start an explosion fine dust will carry it on.

13683. Supposing it did not start an explosion, but only started a non-explosive flame, what would happen then. Would not the air current carry the flame on, and might it not be carried on by the coal dust ?—No: I do not think it would carry it. There would require to be some sudden shock to stir the dust up to get it to a flame first. The dust in our district certainly would not carry more than a few yards.

13684. So that if by chance a great cloud of dust arose and burst into flame without an explosion, you do not think that would do much harm ?—I do not think so.

13685. I understand that your experiments really were not directed to the point of finding out what difference there might be in explosive qualities or in inflammable qualities between very fine dust which was mixed with rock and very fine dust which was entirely carbonaceous ? —Yes; some of the dust was specially taken from the screens, and it was pure coal dust. That showed a larger inflammation than the other, but even with that there was no explosion.

13686. Then your theory is that in order to have an explosion you must have something in the nature of a blown-out shot or some sort of shot to cause an explosion ? —Yes; I think you must have either something in the nature of a blown-out shot or an ignition of gas, or something of a similar character.

13687. Do you suppose that the dust which your experiments would show to be non-inflammable dust could carry an explosion; or must it be dust that would burst into a flame ?—You say "non-inflammable."

13688. Well, you said that about 30 per cent. of the dust was inflammable and the rest of it was non-inflammable; that is to say, that you could not even get a flame out of it ?—Yes; it was inflammable but not explosive.

13689. I thought you said it was none of it explosive, but only a part of it was inflammable ?—That is so.

13690. I was speaking about the coal dust which you were not even able to get a flame out of. Do you think that the coal dust, which was of such a character that you could not get a flame out of it, would still have been

Digitized by Google

Mr. John T. Todd.

21 Feb. 1907.

capable, supposing an explosion had been started, of carrying on an explosion through a mine?—Yes, I think it might.

13691. So that the coal dust which you proved by experiment to be non-inflammable still might be a great danger to the mine in the way of carrying an explosion when once it was set up?—Yes; it might, to a limited degree, in comparison to its inflammability.

13692. But the more inflammable it is, the more likely it is to carry an explosion?—Yes, and I think in any case it would assist.

13693. Even if it was coal dust or not?—Yes, I think anything that was of a fine nature would burn.

13694. You say in Paragraph 2 of your Statement that the most explosive dust is that which is produced by coal and shale or bind, the coal being that crumbling from the sides of the roadways when made in coal or that shaken or blown from trams, shale or bind falling from roof or sides, and becoming gradually reduced to a fine mechanical mixture. Then you would agree, I suppose, with other witnesses whom we have had before us, that it is extremely desirable, with a view to keeping mines as dustless as possible, that the trams should be fairly dust-tight?—Yes, I think so. The trams in my district are fairly dust-tight; they are made of larch boards about 1⅛ inches thick; they are not dovetailed, but they are fitted close together with butt joints, and the bottoms are also larch with wood sole-pieces to carry the axles; the ends are open, with boards either of wood or iron for putting in the ends. Practically three-fourths of the coal is loaded by hand, and it is much easier for a man working in a place to lift the coal into the end than to have to throw it over the top, especially in a lowish seam, and these boards are put into the trams as they begin to load the tram, about half way up the end of the tram.

13695. Those trams, I suppose, are not perfectly dust-tight?—They are not perfectly dust-tight; they are fairly dust-tight.

13696. Then a good deal of dust gets shaken out of the trams?—Very little. The coal is of a hard nature, and a large quantity of it is steam coal and is got in blocks of about 2 feet 6 inches or 2 feet long; those pieces are lifted in, and they do not throw the small coal in; it is hand-loaded coal. In other seams, the softer seams, the coal is principally loaded by a fork with an inch and a quarter between the prongs, and the small dust is left underground.

13696A. (*Mr. Wm. Abraham.*) Is there any space at all between the timber in the trams?—No. Of course it may shrink a little by warping, or anything of that sort, but the two sides fit close together.

13697. (*Chairman.*) We have been told of some trams that have a door at the back on a hinge, and the door is shut when the coal is put in?—There are none that I know of of that kind in my district.

13698. Are you fairly satisfied with the kind of trams that are in use in your district?—Quite.

13699. You think they could hardly be made much more dust-tight than they are?—No. I think Mr. Stokes, our Inspector, said in his evidence that the trams were satisfactory.

13700. Do you spray the trams as they go along?—No.

13701. You do not think the nature of the coal renders it necessary?—It does not render it necessary.

13702. There is very little dust shaken out, you think?—Nor do I think it would be much use.

13703. But the dust does get on to the haulage roads?—There is a certain amount of dust, of course.

13704. But still you do not see your way to lessen that amount very much?—No. I think the only way is by cleaning it up. We periodically clean roads.

13705. You say, then, the finest dust is found on the main haulage roads; do you mean on the floor or on the roof and sides?—Roof and sides.

13706. That would be finer than the dust on the floor?—It would be finer than the dust on the floor, because the dust on the floor is a changing quality and quantity—by horses and men passing over it it is gradually worked up. The dust on the sides and timbers is the finest dust that is blown in the air and gradually caught by the sides and timbers.

13707. You say in Paragraph 8 of your Statement: "Complete watering could not be carried out. Many of the main roads would either be completely ruined or in a dangerous state. Neither would it be practicable to lay down a hard and fast rule with regard to zone watering." You go on to say that if watering is done it must be more than mere moistening, and to go to the fullest extent it would create a danger. With regard to that we have had some evidence before us that a very small amount of watering will have an extremely beneficial effect in stopping explosions; we have been told, for instance, of one case where the dropping of water out of a tub was sufficient to prevent an explosion spreading?—Yes, an explosion may have been stopped in that particular case, but I do not say that that would be proof that it would stop any explosion. I think if watering was adopted, in order to be effective; it would have to be daily watering.

13708. You mean, I suppose, that the roof and the sides must be watered as well as the floor?—If watering had to be carried out that would have to be done.

13709. But, supposing there were difficulties in watering the roof and the sides on account of dangers from falls of roof and so on, and difficulties in keeping up the roof, would it not do a great deal of good to water only the floor?—There are very many collieries in which you would create just as much damage by watering the floor as by watering the roof. With regard to the large number of collieries in which you could not water the roof and the sides, the same remark would apply to the floor: you could not water the floor throughout.

13710. I suppose there are a great many collieries where you can water the floor and cannot water the roof and sides?—There are a large number of collieries where watering could be done on the floor; but in the most dangerous collieries—the most fiery collieries—I should say you could not water the floor.

13711. Because it would heave?—Because it would heave.

13712. Then supposing you bricked the floor, would that do any good?—Your bricks would heave.

13713. Then you speak of the main roads being entirely or completely ruined or in a very dangerous state. I suppose your contention is that if you watered in a place where the strata were such that they would be a great deal disintegrated by watering and could be kept up only with great difficulty, then, in spite of every precaution there would be considerably increased danger to the miners from falls of roof and sides?—There would.

13714. We had it stated in evidence by one witness that the effect of constantly watering the timbers and props and sprags would be to rot the timber?—That is so.

13715. Yesterday, however, we had a witness before us who expressed exactly the contrary opinion; he said that if you keep the wood fairly damp always it is a very good thing for the wood, and that the wood will last a great deal longer?—Not fairly damp. I think it might if you put it into the water and kept the atmosphere from it. But I think any practical person who goes down a pit will see that timber is constantly rotting by reason of moisture getting into it.

13716. The witness yesterday said that if you could only be sure of keeping the wood in a fairly moist condition that would be the best thing for it, and he expressed a very clear opinion on the subject; but he said that if you could not keep the wood constantly moist, but if you sometimes watered it and sometimes allowed it to continue for some days quite dry, then alternations of dryness and dampness might be bad for the wood?—I should prefer to keep the timber dry.

13717. You would prefer to keep it dry altogether?—Yes.

13718. Supposing it was a question of difficulty in keeping your props and sprags sufficiently sound, how would it do to use steel instead of wood?—Steel is largely used now; I use 100 to 150 tons every year both for girders and props; but you cannot use it in every case.

13719. But do you water where those steel girders and props are put?—No.

13720. Therefore you do not know what effect the watering would have on them?—It would not affect the question of watering at all.

13721. They would not be affected by watering?—No, I say the question of watering would not affect the question of putting up steel in preference to timber; I mean I do not connect the two. If you put a steel girder across instead of a bar of timber you would have a certain space between them; if you watered that, even with the steel girders up, you would still get your roof and sides falling in.

Digitized by Google

13722. (*Mr. Ratcliffe Ellis.*) I think the roof in Mr. Fowler's case was practically made of steel?—Mr. Fowler has an exceptional pit, and probably the condition of things existing there does not exist anywhere else.

13723. (*Chairman.*) I was trying to find out whether in your opinion the watering would affect the steel. Do you think it would have a prejudicial effect, as in the case of timber?—Yes, I think it would; it would affect the foundations of the props carrying it and it would loosen the roof, which would become friable.

13724. But would it have an injurious effect upon the steel girders themselves?—I do not think so. I think they would stand that. I have used them for some years now and I have never noticed any difference.

13725. They do not rust?—They do not rust. Might I give you one instance with regard to the effect upon roofs: At a colliery in Derbyshire with which I am connected, during last summer steam was allowed to escape from the shaft bottom at the hauling engine for a few days, and the whole of the roads in the principal district were affected, and eventually collapsed, and new roads had to be made. That was by reason of the water being condensed in the cooler workings and deposited on the roofs and sides, so that everything was wet and eventually collapsed.

13726. Of course, if you know that watering renders the roof and sides liable to fall in, then you would take extra precautions to prevent their falling in, so that it is rather a question of how far it is really more dangerous to the miner; because I suppose with those dangerous roofs and sides, you would take more care, would you not?—Yes; but apart from the possibility of arching the whole of the main roads I do not see that you could protect them—not if you adopt watering throughout. Of course I am not speaking about watering areas.

13727. As regards watering throughout, you think it would be impracticable?—I think it is impracticable.

13728. And that in many cases you could only water if you arched. Could you arch in your mines. In your mines would the arches stand?—I should think in the majority of our mines the arches would stand. There are a few where they would not. Of course I am only speaking of Derbyshire and Nottinghamshire. I know of collieries in Yorkshire and elsewhere where arching would not stand.

13729. I suppose in most collieries there would be probably a great many places where arching would stand?—Yes, a large number. I mean, you would always find some portion of a road that you could arch.

13730. You agree that watering is the best way of dealing with dust. You do not think that very much can be done in the way of brushing the dust away or removing it, irrespective of watering?—I think it would have to be optional. I think you could do either—in areas.

13731. Take, first of all, the question of brushing in areas. Supposing you were to arch over, say, a couple of hundred yards of roadway, and to make that as dustless as you possibly could, do you think that would stop an explosion?—I should not like to say. I do not think it is possible for anyone to say what would stop an explosion unless we have some experiments to prove it. One might assume that it would stop it, but I have seen the result of an explosion through far more than 200 yards of arching.

13732. Wet or dry?—With a damp shaft and in a main road. That was the Elemore explosion.

13733. In 1895 you had a great explosion in your Blackwell Colliery?—Yes.

13734. And the flame was turned aside in that case at a fairly acute angle by a dustless zone. That was so in that particular instance?—Well, I do not agree with that.

13735. Then, what is your theory with regard to it; because there is no doubt whatever that the flame did go down at an acute angle?—As a fact, it did. My explanation is this: To begin with, I do not agree that it occurred from a shot or was a coal dust explosion. I say that it was a gas explosion in the first instance, and that it occurred (if you have the plan before you I think you will see it) right opposite No. 20 main road in the South District. There is an old road there with the name "James Mee" marked on it. I say the explosion occurred in there. That it was a gas explosion to start with. That there was a strong wave current in advance of the explosion of coal dust or the ignition of coal dust, and that the effect of that wave went right to the top of the shaft and carried light articles right up to the surface. That by the time the dust had been inflamed and reached that point at that acute angle the return current had come down the shaft, or, as we call it, the back-lash had come down the shaft, and there was no other road for the flame to travel but that.

13736. You think it travelled simply with the air?—Yes; it travelled with the current of air. There was no other way for it to go.

13737. (*Mr. Ratcliffe Ellis.*) And that it went up the shaft?—I do not say any flame went up the shaft. I say there was a wave current which was set up by the explosion of gas; that was in advance of the ignition of the coal dust, which came after the explosion of the gas. That wave current went right up to the top of the shaft, and a sort of partial vacuum in that way would be created; then came the back-lash—it was the downcast shaft—and the air current again in a very short time, and the full power of the air was against that flame when it reached that acute angle, and it had no other way to go.

13737A. (*Chairman.*) Then you think this explosion does not in any way corroborate the theory that a dustless zone would prevent the spread of an explosion?—Well, that zone was not dustless; it was the main shaft siding. You have a similar case in the Elemore explosion, which occurred in December, 1886. There you had a similar thing, in which the explosion went from the starting point right out through the shaft siding. I do not remember the exact distance, but certainly through 200 or 300 yards of arching; and the flame went right to the surface.

13738. Therefore, in your opinion, there is no experiment and no explosion that you know of which gives you any reason to suppose that a fairly dustless zone will stop an explosion; or, at all events, you think it must be very long if it is dustless?—I think a dustless zone would certainly assist, so far as one can see; but there has been nothing proved yet, so far as I know, by experiment that would enable one to say that a certain condition will stop it absolutely.

13739. In the first place, of course, it would be very difficult to keep a zone dustless; the dust would always be coming back again?—You cannot keep it absolutely dustless. I tried to do so since this Commission sat by clearing roads of 100 yards in length, absolutely sweeping them with soft brushes; and certainly within 24 hours on rubbing your hand along you could get a griming of dust off. So that what the degree of dustlessness is that would stop it I do not know, and that is what I should like to know.

13740. Therefore, at all events, you are not in favour of the alternative mode of dealing with dust that has been suggested, namely, that you should mop it up or sweep it up and put it in tubs and remove it. You think that might do some good, but that it would not be necessarily effectual in keeping a mine safe?—I think it would be a benefit so far as one's knowledge leads one now; but I should not like to say that it would absolutely prevent an explosion.

13741. And you would not rely wholly on the removal of dust by these means?—I would not.

13742. I suppose if you did remove the dust you would slightly wet it first before putting it into the trams. You would not put the dust dry into the trams and remove it dry?—Well, we do. Of course there has to be a certain amount of watering in every mine to some extent for the purpose of sanitation, and we do have a system of watering, but not what would be called thorough watering.

13743. Then you go on to say that in some mines zones could be watered, and I understand you would be in favour of watered zones where it is practicable?—Yes. I think there would have to be an alternative of either watering a zone or clearing a zone and keeping it dustless so far as practicable.

13744. Would it not be far better, where practicable, to have a watered zone than a dry and dustless zone?—Yes, but I think in the larger number of collieries you would not be able to have a watered zone, and that would be so in many of the collieries that are most fiery.

13745. That is to say that you could not have a watered zone at all?—You could not have a watered zone at all.

13746. With regard to this watering in zones, would you leave it entirely with the managers to say what they considered requisite in the matter of watering, or would you leave it with the mines inspector, or who would be the person who should have authority in the matter?—I should leave it with the manager. Supposing an inspector came 20 hours after a zone had been watered, it might be getting very dry. In large currents where you have high velocity of air it would very soon dry up; it would have to be watered daily.

Digitized by Google

Mr. John T. Todd.

21 Feb. 1907.

13747. I was not thinking so much of the amount of watering that you would put on as of the places where zones ought to be placed, and what length of zone there should be, and so on. Would you not have General Rules laid down by Act of Parliament as to how long those zones were to be, whether they were to be, say, 100 yards long or 150 yards long, and what should be the maximum length of road between those zones?—If there is to be a watered zone, or a dustless one, I think the distance ought to be defined either by Parliament or some authority so that it should be general.

13748. You mean the maximum distance between each zone and the length of each zone?—I should not say the distance between each zone; I should say the length of each zone. I think if there was to be a zone it would have to be in each separate ventilating current, that is to say, that if you have a main road with one or two breakages off, and currents of air going into each of those, you would want a zone between each current, to isolate each current.

13749. Subject to that, even if there was a road a mile long without any separate current, you would not think it necessary to have a watered zone?—I would have a zone in each current.

13750. Supposing there was a road with only one current, and there was no question of cross currents anywhere; I do not know how long a road could go on without any cross currents, but supposing there was one road with one current all the way down, say for a mile, and no outlet from that road on the one side or the other, then you would not lay down any rule that the zones might be a mile apart, perhaps—that there should be a mile of road without any zone?—No. I should lay down a rule that if there is to be a zone there is to be a zone in each ventilating current.

13751. But my questionswas, supposing there was one road that length with one ventilating current?—That would be one ventilating zone.

13752. Yes, it would go the whole mile without any cross current or any other form of ventilation?—Yes.

13753. In that case you would have only one zone for the whole of that mile?—That is so.

13754. Supposing you had a shot fired in the middle of that road which would be half a mile from either zone, then the explosion might go half a mile in either direction without being stopped?—Yes. Before you come to the end of my evidence I think you will see I deal with that point. I think the better way is to deal with the shot; that is what I wish to come to afterwards.

13755. But I am dealing at present with the zone. You suggest that some General Rule ought to be laid down, and you say that the General Rule which you would suggest is that whenever there is, as I understand it, a ventilating current, that ventilating current should be cut off by a zone?—That is so.

13756. But my point is this: Supposing there was only one ventilating current going an enormous distance, say a mile, along a main haulage road without any other ventilating current to interfere with it of any sort or kind, then you would not apparently think it necessary to have a zone anywhere along that mile, that is to say, that there might be a mile of road without any zone at all?—That is so; because you would not be firing shots on it. You see you do not fire your shots on your main haulage road except under exceptional circumstances provided for in the Act.

13757. But you do sometimes fire shots on your main haulage roads?—Yes, under special circumstances.

13758. Then I do not understand why you should have zones at all, because I should have thought that if zones were required at all they would be on the main haulage roads?—To prevent an explosion coming out from the face of the workings and travelling the main haulage road.

13759. But I was dealing with the zones on your main haulage roads?—I do not see any object in zones for that. The only reason why I would suggest zones is to prevent the possibility of an explosion from your workings coming out on your main haulage road.

13760. You think as regards explosions from shots on your main haulage roads they ought to be dealt with in a different manner altogether?—Yes.

13761. That is to say, that there should be regulations as to explosives and as to the method of shot-firing and so on?—Yes.

13762. You have referred to the question of the inflammability of dust in Paragraph 12 of your Statement and you think that experiments ought to be made to ascertain what dusts are dangerous and what are not, and the conditions under which danger arises. I suppose you mean that the coal dust should be chemically analysed and that after it was analysed, experiments should be made with a view of finding out the various degrees of inflammability or explosiveness?—I do.

13763. You say, "I believe that since the Explosives Order came into operation no explosion has originated from ignition of coal dust alone, where any permitted explosive now on the list was used, and where the watering, as provided, was carried out. Further, the death rate from explosions is small, and therefore legislation should not be hurried until very full experiments have been carried out." Therefore you consider that if the law is carried into effect with regard to the use of explosives and with regard to watering, there is practically no danger from explosions caused by shot-firing?—Yes. I am dealing there with the main haulage roads.

13764. You say you have had great experience in shot-firing, and you fired no less than 66,000 shots last year?—Yes.

13765. And you always use carbonite?—Yes.

13766. How many out of these 66,000 shots were fired in the main haulage roads?—I do not think there was one fired last year on a main haulage road.

13767. Then you have had no experience of shot-firing there?—I say not last year. We have fired numbers at different times on a main haulage road, but last year we did not fire a shot on a main haulage road.

13768. How many do you fire in the course of a year on main haulage roads, should you say—a good lot?—Perhaps 100. I am speaking now of 13 different seams of coal, not of one pit.

13769. (*Mr. Ratcliffe Ellis.*) What are ripping shots?—They are right in the face of the gates, just a few yards back from the coal face. The ripping shots are all fired at night; they are the shots in the stone for getting the roof down, for making height.

13770. (*Chairman.*) On the main haulage roads do you fire those shots when the men are down the pit?—We fire them at night.

13771. In the main haulage roads always?—Yes.

13772. When the men are not there?—When the ordinary men are not there. The repairers are there, but we fire with carbonite, a permitted explosive, and we fire by an official, and we do watering.

13773. One witness is prepared to declare that he has never known a case of an accident due to shot-firing where the Rules have been adhered to, but that in every case the accident was due to some quite inexcusable breach of the Rules?—I think that is so. I think if you take the accidents that have happened since the Explosives Order came into operation you will find that is so.

13774. And you have not known any case in your experience where there has been an accident from shot-firing which has not been due to somebody's carelessness?—I do not know of one.

13775. You say that the Regulations as to shot-firing should be strengthened, and you suggest the carrying out of further experiments. In Paragraph 14 of your statement you say how you think they should be strengthened: "No shot should be fired on a main haulage road except with a permitted explosive of the highest class." I suppose you would say "any permitted explosive"?—No. I do not know whether there is an intention to do so, but I think the explosives will probably be classified.

13776. You think that permitted explosives should be classified so as to put them under first, second and third class?—I think so; and I think when you want to fire a shot on a main haulage road you should be compelled to use the highest class of explosive.

13777. Why should you always be compelled to use the highest class explosive?—As a matter of safety.

13778. But I should have thought the permitted explosives should only include the highest class, if there was any doubt about it?—I am speaking of the haulage road. There are many mines where you have never any gas at all, and where there is no dust, where it would not be necessary to use the highest class of explosive in the coal face, in the workings; but on a main haulage road, which is admitted to be the place where the finest dust accumulates, and is admitted to be the most susceptible in case of a blown-out shot or flame from a shot, I should use the highest class of explosive.

Digitized by Google

13779. Then you suggest the explosives ought to be graduated, and that there should be a list of permitted explosives, and that a certain number of those should be placed in the first class, and that only those should be used in main haulage roads ?—Yes.

13780. You suggest also that shots should be fired by special persons appointed in writing by the certificated manager. I suppose you mean not only that the shot should be fired by the special person appointed, but that the special person should not be given a general power to fire whenever he thought proper, and that the certificated manager should say in all cases and in each particular case whether the shot should be fired or not ?—That is so ; and that the person appointed to fire the shot should also place the shot in the shot-hole and do the stemming to avoid the possibility of inexperienced people doing the charging.

13781-4. Also that watering should be carried out as required by the General Rule ?—Certainly.

13785. And, if necessary, the shots should be fired when all the ordinary coal getters are out of the mine. What do you mean by " if necessary " there ?—If I had a fiery mine I should prefer to fire the shot at night-time, when everybody was out of the pit, except the persons who were employed in firing the shot.

13786. That would depend upon the mine ?—That would depend upon the mine.

13787. You mention the German system ; you say pipes are of no use if they could not be used. How do you mean " if they could not be used " ?—I say it would be no use laying pipes, as they do in Westphalia, along all the main roads when the roads will not stand watering.

13788. But there might be part of the roads that would stand watering ?—Then that water could be conveyed into them for the short distances.

13789. (*Dr. Haldane.*) It could be conveyed in trams ? —Conveyed in some vessel.

13790. (*Chairman.*) When you say you water for sanitary purposes in your mine I suppose you cannot water all over the mine, because you say there are certain places where you cannot water ?—We do not water all over the mine, but there is a certain amount of water sprinkled—a little water.

13791. For sanitary purposes, to lay the dust, you mean so that it shall not get into the men's mouths and lungs ? —Yes—to make it more comfortable for travelling, similar to the watering of streets on a dusty day.

13792. You say that in collieries subject to spontaneous combustion the danger would be increased by a system of watering ?—Yes.

13793. What do you base your opinion upon in regard to that ?—If you were to put more moisture into the atmosphere in mines in which you are liable to spontaneous combustion, as in some of our mines now, I think you would add a greater danger of setting up heat in the pyrites of the coal and developing a fire. All air and all moisture has to be kept off when you unfortunately get a fire down below.

13794. (*Mr. Wm. Abraham.*) I think the zones that you have spoken of are to prevent the explosions coming out of the working faces ?—Yes.

13795. How near the faces would you have them ?— Probably about midway between whatever junction there was and the face.

13796. Have you considered the question of having zones to prevent the expansion of an explosion after it has occurred, expanding from one current to another, or from one district in a current to another ?—Do you mean expanding along the face of the workings, or coming out on the road ?

13797. Anywhere from one district to another ?—That is my idea of the zones.

13798. That would be when an explosion occurred in the working faces ; but supposing an explosion occurred in a main haulage road, what would you then use to prevent the expansion of that explosion to other districts ? —Use the zone.

13799. Then you are in favour of zones for the purpose of preventing expansion of explosions wherever they take place ?—Yes.

13800. I think we have your opinion pretty fully expressed in the document which you have sent to us ?— I think so.

13801. I should like to put this to you again : in your opinion, no shot should be fired on a main haulage road except with a permitted explosive of the highest class ?— That is so.

13802. That is your opinion ?—That is my conviction.

13803. And that every shot should be fired by a special person appointed in writing by the manager ?—Yes.

13804. By no one else ?—By no one else ; in saying that I am dealing with main haulage roads only.

13805. Quite so ; that is, that every charge which is inserted in a main haulage road should be inserted by the man appointed, and he should stem the hole ?—Yes.

13806. And no one else ?—No one else.

13807. You recommend that shot-firing regulations should be strengthened by law ?—Yes.

13808-10. Will you kindly tell us in what direction you think that is necessary, and how it could be done ?—I have already stated that it is with regard to main haulage roads.

13811. Anything else ?—I do not think so.

13812. Will you think it over for a moment, because this is, as you know, a most important matter ?—Of course, I say carry out the watering ; the watering would be carried out also in firing each shot on a main haulage road. I say that having done that you have strengthened, so far as I can see, every point about the possibility of an ignition.

13813. There is no specific mode of strengthening, in your opinion, beyond those which you have suggested here ? —No.

13814. Do you consider that the collieries under your charge are very dusty, or moderately dusty ?—I have some which I should call fairly dusty ; the others are not very dusty. I have only one wet colliery out of the whole lot ; the others are dry ; but in no case have we high temperatures in our mines. I think the average temperature to-day would be from about 61 deg. to about 68 deg., or perhaps in an exceptional case you might get, say close to a return airway, 70 deg. in one or two cases. As a rule, about 61 deg. to 66 deg. in the workings are the highest temperatures.

13815. Generally speaking what would be the nature of the strata in those collieries ?—As a rule the strata immediately above the coal are either what is called a blue band, which is a sort of blue clay, compressed into stone, or a sandstone rock.

13816. With regard to that blue band, is it hard and strong, or soft and brittle ?—It is hard ; it requires blowing.

13817. So that you have no difficulties of bad top in either case ?—Oh, yes.

13818. Your top is strong in either case ?—No, not in all cases. We have a top of perhaps 2 or 3 feet, in that blue band, and then we have above that sometimes 20 feet of what is called a cockle-bed—shaley stone ; the two or three feet has to be taken down to make the height, and then this stuff follows down.

13819. After your first or second top ripping ?—After the first ripping you come into this soft stuff, which all comes down. That is in certain seams, what we call the Low Main Seams : in the hard coal seams we have not that at all.

13820. What height have you generally without ripping that band ?—Just the height of the seam : it varies from 3 feet to 4 feet.

13821. You have to take the band down in any case ?— Yes, in any case, in that.

13822. So that the working top, as it were, is this soft brittle stuff—not the hard band ?—Yes, in some cases.

13823-4. But my question was generally speaking : I want to know the character ?—Generally, you may take it that it is a blue bind or a hard rock.

13825. You have to rip that down in order to get height in your roads ?—That is so.

13826. Then the top which you have above that is weak, and it comes down too ?—Yes.

13827. Would that in any way lend itself to the increase of dust ?—Not in the faces ; it is all long-wall ; we have very little dust, if any, in the gate roads. The gate roads are cut off—it varies from 100 to 200 yards—and there is very little accumulation of anything in those gate roads within 200 yards of the face. That top which is ripped, or the other that comes down, is put into the packs on the sides and the packings down the roads.

Digitized by Google

Mr John T. Todd.

21 Feb. 1907.

13828. As a practical man you will understand why I am putting these questions: because of the effect that a steam jet would have on your roofs and sides, as you said?—Yes.

13829. Which it would not have if the working roof was of the blue band?—No, not on a hard sandstone roof. I think it would have a bad effect on a blue band.

13830. But it would take a long time?—No, I do not think so. I think it would soon have an effect on a blue band, but I do not think it would have on a sandstone rock.

13831. (*Mr. Smillie.*) You can almost say you are sure it would not?—Yes, I say it would not have any effect on a sandstone rock.

13832. (*Mr. Wm. Abraham.*) On what distance of roads do you say you put that jet which caused a collapse of the roads?—Do you mean from the point where the steam escaped?

13833. Yes?—I should think perhaps 400 yards.

13834. How long did it take to create that effect?—Less than a week when it once started.

13835. It took less than a week?—Yes, in that particular case.

13836. Generally speaking, how often do you calculate you have to change your timber by reason of the effect of watering?—We never change it on account of watering.

13837. You never change your timber because of the effect of watering?—No.

13838. Your cost of timbering is not increased at all because of the watering?—No; I have not said that it is, because we only water partially; we do not water to any extent sufficient to create injury to timber.

13839. But you have given us your opinion, and I thought that opinion was based upon experience of the rottening effect which water does have upon timbers?—I gave you one case where I said steam escaped at a shaft bottom at an engine, and had a certain effect upon the roads. That steam was not purposely put on. I said it escaped. I think you will find that is so.

13840. I do not doubt what you say at all.—I say that I have known pits which were very moist and very damp, and I have known the timber rot very considerably; but I am not saying that it does so in our district.

13841. So that after all to gain experience of timber being rotted, and then causing extra expense you would have to go out of the district?—Yes—that is, to any great extent. Of course, I may tell you you cannot judge our district by reference to Wales with regard to timber. We use very little timber.

13842. But you have expressed rather a strong opinion here upon that matter, and I want to know the extent of your experience with regard to it; that is all?—I do not think I have expressed a very strong opinion. In answer to a question as to whether moisture would rot timber or not, I said I thought it would.

13843. Then you do not think it matters much as to the timber whether it is wetted or not?—I do not think in our district it would affect it very much, because, as I say, we use timber very lightly; but I know collieries in the North of England where, if you had moisture in, it would affect them very considerably.

13844. (*Mr. Ratcliffe Ellis.*) With reference to the Chesterfield experiment, was the dust which you experimented with there merely dust from the Midland district, or dust from other districts as well as the Midland district?—Dust was tried from other districts.

13845. Do you remember whether it was from all districts, or any particular districts?—It was principally from the north-west of Durham, from what is called the Busty Seam, which is supposed to be a most inflammable coal dust.

13846. So that you had not merely coal dust from your own district, the Midland district, which is not supposed to be very inflammable, but you had a specimen of dust which is highly inflammable?—Yes: of course, I am only quoting from the records. I was not there myself.

13847. But from the records it appears that they had a dust which was supposed to be of a highly inflammable character?—Yes, that is so.

13848. The result was that you could not get an explosion, but you found it was more or less inflammable?—Yes, that is the result which the Committee came to.

13849. And you formed your opinion not only from that, but from your own experience, I suppose, that dust will not create an explosion alone?—Yes.

13850. There must either be gas, or would it cause an explosion if there was a concussion from a blown-out shot?—From a blown-out powder shot it might.

13851. But you think the principal danger to be guarded against is not in an explosion arising from coal dust, but from its being carried on by coal dust if it arises from any other cause?—Yes.

13852. You appreciate fully, I suppose, that there is a danger from that?—Certainly.

13853. And a danger which should be guarded against so far as practicable?—Yes.

13854. I suppose in some mines, under some conditions, the mines could be watered?—Oh yes.

13855. Do you consider that there is any condition which you know of—I mean in a natural state of the roads without having any special preparation—under which dust could be sufficiently removed to prevent the consequences being more serious if an explosion happened?—You mean partially. You do not mean removed throughout the whole length?

13856. I mean sufficiently removed?—Yes; I think by removing areas of dust.

13857. Or zones?—The same remark applies to my answer with regard to watering—that it is only areas.

13858. You would rather discountenance a general watering of the whole mine or an attempt to remove the dust from the whole mine?—I do not think it would be practicable at all.

13859. Either one or the other?—Either one or the other.

13860. But you think that where it is necessary zones might be provided which should either be cleared of the dust altogether or should be watered sufficiently?—Yes. Of course with regard to clearing them altogether of dust you could only clear them as far as it is practicable to do so.

13861. I should like to ask you this question: Can you clear an area sufficiently to prevent the consequences that we all want to avoid?—I do not know. As I say, I should like to see some experiments which would prove what dustless area would stop an explosion. I do not think it has ever been demonstrated yet. At the same time I think, so far as one can see, it would assist to have such dustless areas; naturally it would help to lessen the danger.

13862. You have a tracing of a plan with you showing the actual working in a mine?—Yes.

13863. That is a tracing of a long-wall working?—It is a tracing of an actual pit in operation. (*Plan produced.*)

13864. The circular lines show the different workings in different years, 1904, 1905, and 1906?—Yes.

13865. The coal is all got out, and the gradual advances each year can be seen from the plan. It was there in 1904, there in 1905, and there in 1906 (*Pointing*). Will you point out the main haulage road on this?—This is the shaft, and the main haulage road is here. There are roads built in as the coal is taken out, and as those roads reach 100 yards or 150 yards—it depends upon the nature of the roof—there are cross roads put, and then *this* is all abandoned (*Witness explained plan*).

13866. *This* is the present face. Now along the face there is no great accumulation of dust of an explosive character?—None.

13867. So that there is very little danger, if any, of a dust explosion or of an explosion adding to the effect?—I do not think there is any.

13868. Until you get to the main haulage road, from these different roads from the face is there much dust?—No.

13869. Where do you find the dust begins?—After one reaches the mechanical haulage on the main road.

13870. So that it is from the place where you reach the mechanical haulage that the dust accumulates?—Yes.

13871. In fact does it amount to this, that the roads from the face to the junction of the main haulage roads are in effect protected areas?—Yes—any dust there is is stone dust.

13872. So that in those long or short distances, whatever they may be, until you get to the main haulage road there is no dust, in your view, upon those roads which would have any effect upon an explosion?—That is so.

13873. (*Chairman.*) Why should there not be coal dust?—I say not sufficient to cause an explosion.

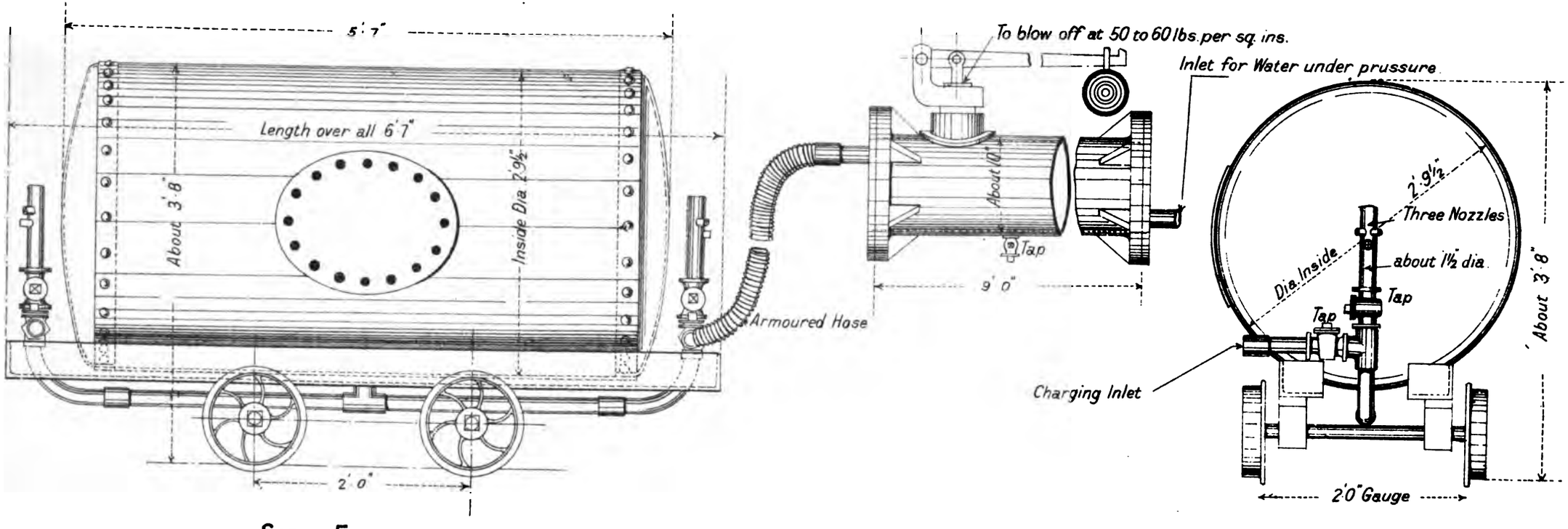
Digitized by Google

Digitized by Google

ROYAL COMMISSION ON MINES.

WATER SPRAYING APPARATUS

IN USE AT THE BLACKWELL COLLIERIES.



SIDE ELEVATION.

END ELEVATION.

SCALE ¾ INCHES TO A FOOT.

Digitized by Google

Waller & Graham, Ltd Litho London

13874. You mean it is so much mixed up with stone dust?—Yes, and there is a small quantity of coal coming out of *these*. (*Witness further explained Plan.*)

13875. (*Mr. Ratcliffe Ellis.*) But in this long-wall system the roads that come from the face to the main haulage road are practically free from dust?—Practically free from coal dust.

13876. And, in your view, supposing that an explosion happened at the face, is there such an amount of coal dust on these roads communicating with the main haulage road as to carry the explosion on to that road?—No, I think not.

13877. If that is so, then in effect between the face and the main haulage road there exist a number of protected areas?—Yes: I am only speaking of our district, of course.

(*Mr. Cunynghame.*) It is rather a strong thing to say that with regard to every mine.

13878. (*Mr. Ratcliffe Ellis.*) I agree. First of all you speak of your own collieries: is that the case in your collieries?—Yes.

13879. So far as you know is that the case generally in the Midland District?—Yes; I think my collieries are typical of the Midland District.

13880. I will not go any further than that?—No, of course I do not wish to go further than that.

13881. But in the Midland District that is the state of things?—Yes.

13882. In effect it is this, that between the face and the main haulage roads where the danger is, these roads (*indicating on Plan*) constitute a protected area—a protected zone?—That is so.

13883. In working longwall do you think it is necessary (taking your own district and your own pit, if you like) between the haulage road and the face in the long-wall working, to have in the intermediate roads a specially protected zone?—No, I do not.

13884. (*Chairman.*) I understand the goaf is only packed within a certain distance of the face, and therefore if an explosion began here it might traverse the whole of that (*indicating on Plan*)?—Yes.

13885. My impression is that one witness said where you had a very long face of long-wall working it was quite possible for an explosion to begin at the face and to work all the way along *here*.

13886. (*Mr. Ratcliffe Ellis.*) We will take it a little further: this specimen which you have given you say represents your district fairly?—Yes.

13887. Does it represent a dry and dusty district: is your district a dry and dusty district?—Well, it is dusty. Of course there are degrees of dust: I do not know where one would start to describe what is dusty as the beginning.

13888. That is as the standard?—As the standard; but I say that in our case we have no hot mines; the temperatures are low; and I should not call them dry and dusty, although I would call them dusty; they are dusty, undoubtedly.

13889. Do you draw a distinction between fiery mines and non-fiery mines as to the precaution which should be taken?—Yes.

13890. Do you think in this instance which you have shown, this precaution was sufficient as between the face and the main haulage road in a fiery mine?—No, I should not say so. With regard to that plan and what I have said about the faces, it entirely applies to faces in our district which are not fiery.

13891. In a mine which is a fiery mine what additional precautions would you suggest: I will first of all take it in the way of zones: would you have any protected zone between the face and the main haulage road?—I think there would have to be in fiery mines.

13892. Now with reference to the character of the protection: first of all, what is the danger to be guarded against?—An ignition from a blown-out shot, or an explosion of gas.

13893. That is to say, that in case of a blown-out shot or an explosion of gas, the dust in the roads would make it much more disastrous?—Of course, I am speaking of a blown-out shot from gunpowder, which is very little used.

13894. That is so, is it not; supposing there was an explosion of gas, however it arose, the dusty character of the roads would make the explosion more disastrous in its consequences?—I think so.

13895. Did you go to Courrières?—No.

13896. In order to guard against the consequences of an explosion, rather than the originating of an explosion, something is desirable in order to limit the extent of the explosion and to stop it?—Yes.

13897. With reference to the zones, could you, in your view, have a zone which could be kept sufficiently clear of dust to secure that object, unless it was specially prepared either by arching or constructed in some way different from the ordinary road in a mine?—In the case of an ordinary road in a mine you could sweep as clear as possible: I do not think you could get absolutely every particle of dust away, nor could you even if you had arching; still, a certain amount of dust would cling; but I think in any ordinary case you might sweep up an area and deal with it day by day by sweeping it.

13898. Without specially prepared arches?—Without specially prepared arches.

13899. With reference to the question of having arches, are there not cases in which you could not maintain them by reason of the depth below the surface, or for other reasons?—There are no cases in my own collieries where you could not maintain them but I do know of cases where they could not be maintained.

13900. Either in consequence of the great crushing weight above them, or, in cases where you had a series of mines, wanting to work one under the other, arches would have to be in each of the seams?—I think the distances generally are far apart enough not to create damage in that respect. It is the crushing of the soft sides and the lifting of the floor.

13901. But I understand there are cases which you know of where masonry, however constructed, could not be maintained?—That is so.

13902. In such a case as that, if the precaution had to be taken by clearing the dust, you would have to deal with the ordinary roads in a mine?—Yes.

13903. Do you think a road could be sufficiently cleared of dust for the purpose that is required, namely, that there should not be enough dust left there to continue an explosion?—In my opinion it could be done; but, as I have said before, I should like to know what is the least dust that will continue an explosion, and that none of us know yet.

13904. That you think is a matter for inquiry; but your view is that it might be made sufficiently clear to prevent it?—Yes.

13905. In fact, an area might be made so clear of dust that there would be nothing for the flame to feed upon, and if you had such an area it would stop it?—I think it might be done.

13906. Still, information is required as to what quantity of dust would carry on an explosion?—Yes.

13907. If it could not be done by clearing the roadway, the next remedy is watering it?—Yes.

13908. Rendering whatever dust there is there harmless as far as possible?—Yes.

13909. Do you generally favour one system more than another, or would you let the manager be guided by the conditions of his mine as to whether he would adopt one system or the other?—I favour the clearing of the dust rather, for this reason: I do not know of a single mine in our district that would stand watering on the roof and sides. I would rather water if the roads would bear it, but there is not a single pit that I have where the roads would stand it.

13910. You make a suggestion, I believe, as to the method of watering which you adopt yourselves?—We have a system of spraying in operation now.

13911. Is the system of spraying enough, do you think?—Not enough to prevent an explosion. You could prevent an explosion by taking an area.

13912. By a zone?—By a zone.

13913. Would you mind shewing your method to the Commission? (*The Witness produced a drawing.*)*—This shews an iron tank containing about 200 gallons of water, and I am presuming that it is full of air to start with. We attach a pipe from any water source, either from a head of water at the shaft or from a pump on the surface, and pump water into it; as the water is forced in, the air

* *See* Plate XI.

Digitized by Google

Mr. John T. Todd.

21 Feb. 1907.

is compressed up to the top and we compress it up to about 50 lbs. or 60 lbs., and then shut it off and take it away, and it is only necessary to open the taps then, and the compressed air inside will expand down to atmospheric pressure and force out the water. To get the air sufficient to force out the whole of the water we pass the supply through a 9 feet length of 10 inch pipe, and the extra air which is in that pipe which is also forced into that tank is sufficient to press out the whole of the water. The sprays are very fine, with wires across to make the water spray. That will run on an ordinary road for about three-quarters of an hour.

13914. And that sprays the roof, the sides and the floor ?—Yes—of course only to a limited extent.

13915. That you do not think would be sufficient to prevent carrying on an explosion ?—I do not think so, to the extent that we are doing it.

13916. You are doing it for what you call sanitary purposes ?—Yes. There are no working parts about it at all; the water loads from pressure and the air simply compresses it.

13917. (*Chairman.*) Why do you form the opinion that spraying in that way would not be sufficient to stop an explosion ?—You see, we are not spraying for that purpose.

13918. I know you are not spraying with the view to stop an explosion, but it seems to me from what has been stated before us, that it is not by any means certain that watering to that extent would not stop an explosion ?—No, because we do not know what degree of watering would do so.

13919. You say that in your opinion it would not ?—Yes.

13920. And you do not do it for the purpose of stopping an explosion ?—No. You could water to such an extent as to saturate everything.

13921. You do it for sanitary purposes ?—Yes.

13922. Consequently it does not do much damage, or you would not do it ?—Therefore we do it to a small degree.

13923. Consequently you can water without occasioning any serious danger of falls of roof and sides ?—Yes.

13924. So that if it can be proved that watering a roadway to that extent would prevent an explosion, you would be willing to water to that extent ?—Yes; we do now.

13925. Do you constantly keep it moist; or what happens a few hours afterwards ?—We do it about once in 24 hours.

13926. And at the end of the 24 hours I suppose it is not quite dry, is it ?—It is just a little moist; sometimes it is dry. These sprays are attached to the ordinary trams going in.

13927. There would be no object in letting it go for sufficient time to make it perfectly dry; so long as you never had it wetter than you have it now, you can do it once in 12 hours, I suppose ?—The mines are only worked in one shift in our district, and these spraying machines are run in during the day with the ordinary trams in the pit; at night-time after 5 o'clock there is no work done there.

13928. It would only be at night-time that the roads would be dry, probably; during the whole time the men were working, the roadway would be slightly moist ?—Yes, I should say it would be slightly moist; but I would not say it would be wet.

13929. You would not say that it would stop an explosion ?—I should not.

13930. We have had it stated in evidence that sometimes a very small amount of moisture has been sufficient to stop an explosion ?—Yes, it has been stated, I understand.

13930A. (*Mr. Ratcliffe Ellis.*) That extent of watering which you have described would be no great hardship upon anybody to do ?—No.

13931. Does it require very much water to do that ?—No.

13932. Supposing that you had to water the whole of your mine, as suggested, according to the German system, have you any idea what the cost of the watering would be—laying pipes, and so on ?—I have tried watering lengths of 100 yards in different pits, and to keep it thoroughly wet it would require about 12 gallons a yard.

13933. Have you that quantity of water available about the pits for nothing ?—No; it would take in one colliery alone about 200,000 gallons of water per day.

13934. (*Chairman.*) You say this spraying machine goes for three-quarters of an hour ?—Yes.

13935. How far would the spraying machine which you have, holding the 200 gallons, run in three-quarters of an hour ?—About a mile, I should think.

13936. Therefore, you say that for sanitary purposes you use about 200 gallons a mile ?—Yes.

13937. Whereas for complete watering purposes you would use in a mile an enormous quantity ?—About 20,000 gallons.

13938. That would be 100 times as much ?—Yes.

13939. (*Mr. Ratcliffe Ellis.*) And the quantity you have mentioned there is an actual trial ?—Yes, an actual trial made at our own colliery.

13940. Have you any supply of water in the mine ?—No; the water that would be required in each of the collieries is far in excess of the water we use for our boilers for steam purposes, and in the summer time we are often short of water for that purpose.

13941. You would have to buy that water from somewhere ?—We should have to buy it from somewhere, if we could get it.

13942. Have you any estimate of the cost of watering—I do not mean of the spraying, but of the experiment that you have tried, which you have mentioned ?—No, I do not disagree with the suggested costs for watering alone—1d. or 1½d. per ton, or something of that kind, for the actual watering.

13943. But the incidental costs would be very considerable ?—I do not know what the cost of damage to the road might be; you might put it at 3d. or 4d., probably.

13944. May I assume, from what you say, that you think certainly in fiery mines where it is practicable there should be protected zones established in all the air roads ?—I think so.

13945. Would you agree that it should take something of this shape—that an air road of a particular length should have in it one or more protected zones ?—Yes.

13946. The length, of course, would be a matter for consideration ?—Yes.

13947. You would leave it to the manager to decide, from the conditions of his pit, whether that protection should be given in these areas by cleaning them from dust or by watering ?—Yes, I think there is bound to be an alternative; there must be an alternative.

13948. He must have that discretion ?—Yes.

13949. Are there cases in which it would be impracticable either to have one or the other ?—I think not, if one knew what "dustless" meant. It can be kept clear as far as possible.

13950. There are mines in which it would be impracticable to have one or the other, but those may not be mines where it would be necessary ?—It might not be necessary. But I do not think it would be impracticable to keep clean a certain defined length of roadway by sweeping up.

13951. If absolute cleanliness was not necessary; but that you are in doubt about ?—There might be a difference of opinion amongst people who looked at it as to whether it was dustless or not.

13952. It has been suggested that there are many cases in which it would be impossible either to water, because it would bring the whole place in, or in which it would be impossible to have these areas, because you could not clear them from dust unless there were arches built, and that there it might be impossible to get masonry to stand: and, therefore, that neither watering nor building arches so as to have the roads clean would be practicable. Do you agree with that ?—I think that may be so, but at the same time I think it would not be impossible to sweep up and keep clear a certain area.

13953. But when you say it is possible to have an area clean, you are assuming that it does not need to be absolutely clear of dust ?—Certainly—it could not be.

13954. If a very small quantity of dust could cause all this mischief, then you could not have them sufficiently clean without having a specially built or prepared road ?—Even then you would not have it always absolutely clean. If you cleaned it at one particular time after you had commenced running coals through, there would be a certain griming of dust which would lodge about the places.

Digitized by Google

13955. Supposing there to be cases where neither the one nor the other is reasonably practicable, can you suggest any arrangement with regard to the shot-firing which might induce greater safety?—Yes. I think that the shots on the main haulage roads should be dealt with as I have already suggested, and that in fiery pits nothing but the best explosives should be used, and that all the shots should be stemmed and fired by an official.

13956. We will take the shots at the face. You fire a great many shots at the face, apparently?—Not a great many.

13957. I see that the number fired in the coal is 13,446?—Yes, but that is for about 12 or 13 pits.

13958. Well, you fire those shots. The collier, I suppose, drills the hole?—The collier drills the hole.

13959. Then does your shot-lighter charge it?—Our shot-lighter charges it.

13960. And fires it?—And fires it.

13961. Do you recommend that in all cases of fiery mines all that the collier should do should be to drill the hole? I do.

13962. That the charge should be put in by the shot-lighter and that he should fire it?—Yes.

13963. Have you any suggestion to make beyond that with reference to firing shots in the coal, that is, beyond what is provided for in the Act of Parliament and under the Explosives Order?—No.

13964. Do you think that is sufficient for safety?—I think that is sufficient.

13965. In regard to the haulage roads (you have already given us your suggestion as to that) what is the necessity for firing shots?—Sometimes for enlarging it, sometimes for making refuge holes.

13966. It is to get the stuff down: that is the object?—That is the object.

13967. Could it be got down—I suppose not quite so easily—without shot-firing at all?—In some cases it could.

13968. In cases where it was a fiery mine and where it was impracticable to have either protected areas by watering or protected areas by cleaning the dust, do you think it would be desirable to stop shot-firing in the main roads altogether?—If you have a safe explosive there is not the danger from the flame at all.

13969. You think that if care is exercised there could be shot-firing in main roads without any danger?—Yes, I think so.

13970. Even in fiery mines, and even where the road is dry and dusty?—I think so.

13971. And the only suggestion you have to make beyond what exists at the present time is that the shots should not be fired except under the direct instructions of the manager?—Yes, I think that should be so.

13972. Would you suggest that that should be made a General Rule? There is a Special Rule in Lancashire to this effect: "Shots shall not be fired on main haulage, or main intake, or main return roads, except with the special permission, in writing, of the certificated manager, and the requirements as to watering shall be carefully attended to." Do you think that might be made a General Rule?—I do.

13973. With those conditions do you think firing on main haulage roads might be brought to reasonable safety?—I do. But I should like to see some experiments well carried out as to explosives and the existence of dust under conditions that prevail in a mine.

13974. Then your view is that there is not sufficient knowledge at the present time to absolutely prescribe what is best, but with the knowledge which you have, those are your recommendations?—That is so.

13975. (*Mr. Cunynghame.*) I think in order to have complete watering so as to make it reasonably effective against dust a zone at all events would have to receive an amount of from 12 to 15 gallons a yard; that is your estimate?—That is my estimate.

13976. That wagon would apparently carry about 216 gallons. Roughly speaking it is about 200 gallons?—Yes—we call it 200 gallons.

13977. But there would be no room for any air in that case?—It is able to carry 200 gallons with the air in it.

13978. With the necessary air to squirt it out?—Yes.

13979. I am afraid it would be rather a feeble jet at the end, would it not?—No; we have them working.

13980. You have only 60 lbs. pressure here?—That is so.

13981. Therefore you have not much air left to compress; but I will assume that this is sufficient; consequently you would require in order to water 100 yards of zone, about seven wagon-loads?—Yes, about six to seven wagon-loads.

13982. Supposing you had a sufficiently-watered zone for the purposes of safety, how often would that watering have to be done in the 24 hours?—I think once in every 24 hours.

13983. You would have that done before the shifts commenced?—Yes.

13984. At the beginning?—At the beginning.

13985. Are you working in double or single shifts?—Single shifts.

13986. The effect of that would last well over one shift?—Oh yes.

13987. What would be the expense of this as compared with stand-pipes? Would it be very much cheaper, assuming you wanted seven wagon-loads?—If you wanted seven wagon-loads you would get your water very often at the bottom of your pit; you would load them and draw the water in, and you would soon get your seven wagon-loads in.

13988. I agree, but would it not in the long run be as expensive to build the number of wagons that would be required to do this watering as it would after all to carry stand-pipes there and have done with it?—I should not think so. Those wagons would cost about £18 each.

13989. You would require a large number of them to water, because if you had only a few of them you would have them blocking up the traffic on the way, and you would have to get past somehow?—But you could take them in whilst you were drawing in your ordinary trams; you could water 10 yards and do the next 10 yards continuously half-hour after half-hour.

13990. Then we may take it from you that at all events with any system of zone watering this wagon system would be probably cheaper, or at any rate, not dearer than a system of stand-pipes?—Certainly.

13991. We may take the stand-pipe figure, consequently, as the outside that would be required?—Yes.

13992. I suppose you would agree in regard to safety zones that they seem to present two advantages; in the first place they isolate the flame; and secondly, if an explosion takes place at last, there would be large areas which would be free from the poisonous gas produced by the explosion, and into which people could escape?—No, the zones would not stop the effect of the gas, or the effects from an explosion, the afterdamp, and so on.

13993. But it would largely do so. Can you tell us what proportion of poisonous gas is formed in the air when an explosion of dust takes place?—I should not like to say.

13994. You see my point: when an explosion of gas takes place in a length of road, what proportion of poisonous gas would it form—what percentage in proportion to the air in that area—and what percentage is necessary to kill a man; how much dilution would be needed so that a man might get out?—Pardon me; would you not wish to take another point into consideration if you had the explosion which you are suggesting.

13995. Yes, limited to a space between zones?—You, would have all your air arrangements blown to pieces, shattered.

13996. I do not think you would in a case of that kind if you had got such a limited explosion, would you?—But if you got an explosion, it probably would never be quite so limited as you seem to put it, and there would certainly be a given area over which you might have the explosion.

13997. Assuming you have got your air-fans rendered useless?—I do not mean the fan; I mean all your internal arrangements in your workings blown to pieces; and then you have that gas disseminated away into any other part of that ventilating current.

13998. Then it would be likely to poison the whole mine, would it not?—In that particular ventilating current. If the other ventilating currents were left separate, the men in those other ventilating currents would be all right.

13998A. You follow my point; what is the use of having a zone if one zone when it explodes is going to poison all the rest? I want to put the difficulty which occurs to one's mind. The zone system would make it much safer, but there still seems to be the question of the poisonous gas left. Then the poisonous gas would be

Digitized by Google

Mr. John T. Todd.

21 Feb. 1907.

immensely weakened, because it would have only occurred over a small portion, and the other part would be safe ; or if it mixed through the mine, it would be all weakened down throughout ; there would be a great deal less of it ?

(*Witness.*) That is so.

13999. I suppose that is all we can say at present ?—Yes.

14000. At all events, we may take it—it is common-sense—that if the general principle of zones would arrest explosions, there would be a vastly less quantity of poisonous gas formed in the mine to poison people ; at present that is clear ?—That is clear.

14001. At present we are not in a position to say what particular effects it would have upon particular districts ?—That is so.

14002. Now I will pass to another point. I understand that, in your view, it would be desirable that zones should exist on the main haulage roads as near in-bye as you could have them ?—Yes.

14003. The most inner zone would be fixed as near in-bye as possible ?—Yes ; I should put it between the end of the mechanical main haulage and the workings.

14004. Would you have any objection to have a specified distance named from that in-bye towards the pit mouth ; a specified distance of main haulage road which should not be allowed to exist without a zone. Do you follow what I mean : that there should be no greater length than such and such a length. Do you think it should be enacted that there should be zones placed at the ends of main haulage roads as near in-bye as possible, and that thence outwards no main haulage road should exist of a greater length than a certain length to be specified without being interrupted by an efficient zone ?—No, I do not agree with that altogether. If you have a zone in-bye between the end of your haulage and your face, I do not see the necessity for having a zone on your main haulage road.

14005. But you may have an ignition between the pit mouth and the most inner zone that you speak of ?—On your main road ?

14006. Yes ?—From what do you suggest that ignition might come ?

14007. From a dozen causes ; you might have an electrical machine go wrong, and so long as you have dust there, and possibly gas, you may have an explosion.—We have on our main haulage roads all open lights.

14008. Yes, on yours ; but how would it be if it was a mine in which safety lamps were used along the main haulage roads ?—I would rather take it as between a fiery mine and a non-fiery mine—not a safety lamp pit.

14009. I think it comes to the same thing ?—It is not quite the same thing ; many people put safety lamps in where they are not needed, and where there is no gas.

14010. But take it to be a mine where they need safety lamps ?—Yes, there I agree with you.

14011. There you would not like to leave a haulage road perhaps three miles in length without any zone at all ?—I cannot see any danger on your main haulage road where all your fresh current is.

14012. (*Dr. Haldane.*) There is no danger from gas ?—There is no danger from gas, and you are not going to fire shots there except under very strict conditions. I do not see any necessity for zones.

14013. (*Mr. Cunynghame.*) You would fix all your zones between the face and the main haulage roads ?—That is so.

14014. That is, in your opinion, the proper place for zones ?—I think so.

14015. Still, it would not be a very hard provision that there should be other zones at certain distances between there and the pit mouth so as to make it sure, would it ?—I do not know that it would be any great hardship, but I do not quite see that there is any necessity for it.

14016. If it left the first zone there would be a chance of its getting stopped by the second ?—I think it is better not to put anything in that is not necessary.

14017. We are all agreed with regard to that, of course. Then I suppose, in case of dispute as to whether the zones in a mine were sufficient according to the provisions of a proposed Act of Parliament, you could leave the matter in dispute to be settled in the same way that disputes are settled now ?—Yes, in the way in which disputes are settled under the Act now.

14018. I might ask you a few questions about cost. Can you give us any figures as to cost ?—No ; I was asked a short time ago about that, but I have no figures which I can give. I should feel disposed to accept the figures which have been given already.

14019. There are some very great discrepancies in the figures given, and I should like to know which one you agree with ; for instance, apart from repairing difficulties—taking solely the cost of putting in pipes, and paying the interest and depreciation fund on that, putting that as one item ?—Yes.

14020. That put the wages as another ; would you put it higher than 2d. per ton ?—No ; some time ago I said I thought from about 1d. to 1½d. I worked it out roughly on some of our own pits to see what it would cost.

14021. Some of the witnesses have given the figure to us as 1½d ?—Yes, that is what I had in my mind.

14022. (*Mr. Enoch Edwards.*) Your observations are based largely upon your Nottinghamshire or Derbyshire experience ?—Quite as largely on Durham experience.

14023. The explanations which you have been giving about the working faces apply to Derbyshire ?—Yes.

14024. Have you had much experience in explosions ?—Unfortunately I have been through a few. I went through the Elemore explosion ; I was down at Seaham ; and also at Brancepeth in 1896.

14025. Have you been so unfortunate as to have an explosion at the collieries which you are managing ?—No. There was an explosion at the collieries where I am now managing a short time before I went there.

14026. With regard to the explosions of which you have had experience, had you any knowledge of those mines and the working of the mines prior to the explosions ?—With regard to Elemore I had ; I had charge in that particular mine for some time before.

14027. But you were not managing it ?—I was not manager at the time.

14028. Would you be able to satisfy yourself as to the condition of the mine before the explosion ?—Well, I had not been down for probably a month before the explosion in that particular pit, but I knew it well.

14029. Was the particular explosion you mention a gas explosion ?—It was never decided. Some people put it down to a shot on the main haulage road, a blown-out powder shot, and others could not explain it at all.

14030-1. I suppose you are aware that there are mining engineers who hold the opinion, strongly, that you may have dry zones without water which will prevent the spread of an explosion ?—Yes.

14032. You have perhaps read Mr. Fowler's evidence ?—I have not read his evidence, but I know Mr. Fowler very well.

14033. You know his colliery ?—I know his colliery.

14034. You know his method ?—Yes, of sweeping and cleaning up.

14035. Of course you say you are not able to judge as to how great or how small a quantity of dust would be necessary to continue an explosion ?—That is so.

14036. I suppose you would agree that the less dust the less risk ?—I quite agree.

14037. I understood you to say that there was no danger in a long-wall face from an explosion. What did you mean by that ?—No, I said with regard to that particular plan to which I was referring there was no danger of an explosion in any of our long-wall faces at the face, from coal dust : there was no danger from coal dust at our faces.

14038. There may be danger of gas ?—There might be, but we are practically gas free in our district.

14039. So that yours is not a typical colliery, after all ?—It is a typical colliery of the district.

14040. But it is not what may be called a colliery that is dangerous by reason of high temperature and being dry and dusty, and there being gas ?—None of the mines in the Midland district are, I think. If you look at the record of accidents you will find that the numbers of accidents from explosions are very very small all throughout the Midland district.

14041. There was a suggestion made with reference to your spraying. I understood you to say that that spraying was not enough to prevent an explosion ?—It was not carried out to that extent.

14042. That is to say, it was not carried out in order to prevent an explosion ?—No.

14043. You mean you must have some conditions—an explosion created by gas or blasting—and that in that

Digitized by Google

case spraying is not sufficient ?—It is not sufficient so far as we now carry it out. I said it could be carried out to spray a zone sufficiently.

14044. But the term used was rather different. Did you mean, to prevent the spread of an explosion. What you said was that spraying was not enough to prevent an explosion ?—I meant the spread of an explosion.

14045. In dealing with watering of course you refer rather to dry and dusty mines in which it is dangerous to the sides and roof to water ?—Yes.

14046. It is hardly correct to say that directly you get a certain temperature in a damp mine the timber rots and decays in the sense in which you describe it, is it ?—I think it rots and decays in any damp mine.

14047. In the upper seams, where I suppose the temperature has much to do with it, timber in roadways stands for years, in the wet mines ?—Yes, but they are constantly repaired, I presume.

14048. The cost for timbering those mines is not so large as in the dry mines. I have had some experience upon this point, and I suggest to you that the cost of timber is not nearly so great in the wet mines as in the dry mines ?—I have only one colliery which is wet, and we pump up to 1,000 gallons a minute, and we supply all our other pits with boiler water. It is a very wet mine, and it is the most expensive pit I have known for timbering in our district ; and it is a thoroughly wet pit.

14049. Would you consider that in a very dry mine without water a timber bill of 1s. per ton is a big cost ?—I should call a timber bill of 3d. per ton a big cost.

14050. And you would consider that it was more reasonable in a wet mine which only cost 2d. per ton ?—Certainly. The timber bills in our district are exceedingly small.

14051. This is the point which I rather want to make with regard to this : the bulk of your evidence is based upon your experience in Derbyshire ?—And in Durham.

14052. But the whole of the Statement which you have handed in is based upon experience in Derbyshire ?—No, I should not say that. My experience of dust, and so on, is perhaps more in connection with Durham than in connection with Derbyshire, because I was in Durham for about 20 years in mines.

14053. The suggestion was made to you that in watering the face there was great danger and risk. It would not be correct to say that by watering the coal face you could get the coal without working ?—No.

14054. Otherwise, instead of men using powder and explosives, you would have a water hose turned on and get your coal in that way ?—In our coal, for instance, there is a large quantity of moisture, as much as 5 per cent. to 7 per cent. in a seam, although it is dusty.

14055. In firing shots in your main haulage roads you suggest that the shot should be fired by a special person appointed in writing by the certificated manager ?—Yes.

14056. Do you mean appointed for that particular shot ?—For that particular shot.

14057. You do not confuse this person to be appointed with a fireman or a roadman, who is generally accepted as a responsible person to fire shots anywhere ?—No.

14058. Do you suggest that the manager himself should be conversant with the particular locality in which the shot is to be fired before he gives authority ?—Certainly.

14059. May it not be possible for a manager to give authority in writing from his office at the top without seeing the locality ?—It is possible for him to do it.

14060. Do you not think that happens in practice ?—No, I do not think so at all. I think the manager realises his responsibility far too much with regard to firing on the main haulage road for that to happen. Of course, there may be exceptions, but I am speaking generally.

14061. If the manager has to go down and see it, what is there to prevent him firing it himself ?—Because he might go not at the time when the shot has to be fired. He might go some hours before. He might be there in the morning, and might be arranging for the shot to be fired at night. He would then give his certificate to whoever had to fire the shot, to go and fire that particular shot at any time, whenever it was.

14062. Is that the practice now at your collieries ?—Yes.

14063. At all your pits ?—All of them. I think generally it is so in our district.

14064. That is to say throughout Derbyshire ?—Yes.

14065. You have referred to blown-out shots with gunpowder ?—Yes.

14066. And you say that there is great risk. Why is there great risk from gunpowder ?—From flame.

14067. Are there any other explosives from which flame is emitted ?—There may be ; but if there are, as I say, I should get the safest explosives and let us deal with them.

14068. I am putting to you that if any gas is seen and you place your faith in a particular explosive, it is well for us to know whether that explosive is the safest of all. Are there any explosives in use which do not emit flame when the shot is blown out, and not stemmed properly ?—I have used carbonite, bellite and ammonite. I have watched a lot of the shots, and I have never seen any flame from them. There may be a small flame, of course ; there is a small flame from the detonator, or I should say I do not know whether there is flame from that or not. With regard to that part of my argument, it is that I should like to have all those explosives thoroughly tested and classified, and if they are liable to flame I should say remove them.

14069. So that when you use the term "safest blasting agent," it is a question of degree of safety ; you do not assume that all those explosives are absolutely safe ?—No ; all I can say is that I have used carbonite now for ten years and have been firing between 60,000 and 70,000 shots a year, and I have never had the slightest mishap from that.

14070. No ; but I understood you to say that you have no gas in your collieries ?—We have a little ; but I mean we have not had a mishap from a blown-out shot. Of course, the mishap would come from the blown-out shot.

14071. (*Dr. Haldane.*) You do not mean to doubt that even carbonite would fire an explosive mixture if you used enough of it and used it carelessly enough ?—Yes ; to fire a shot I think the action of the higher explosive is so quick that you do not get the flame which you would from a slow explosive like gunpowder. You could not get the flame outside the shot-hole, I think, with the higher explosive.

14072. But you are aware that it has been fired with the safest explosive ?—With a shot-hole stemming in it ?

14073. No, unstemmed ?—That is what I say, that if you have a blown-out shot you would not get the flame from a high explosive that you would get from gunpowder, I think.

14074. (*Mr. Enoch Edwards.*) What you have said in your Statement is with regard to a blown-out shot ; of course, the danger arises more largely from a blown-out shot than a shot that does its work properly, when the shot is properly holed and dressed ?—Yes.

14075. What you suggest is that you get with a blown-out shot more liability to flame, simply because there has been no resistance ?—Yes.

14076. Would not that apply equally to the explosives you have mentioned ?—I think not.

14077. Not to the same degree ?—To nothing like the same degree.

14078. But it would apply ?—I do not think it would apply even to a dangerous degree. I do not think there would be any danger from a blown-out shot.

14079. Have you experimented yourself at all with these explosives?—In the way of shots do you mean ?

14080. Yes ?—I have had one blown out last year, but no flame of any sort was seen by the people who were there.

14081. (*Chairman.*) Was that due to anybody's carelessness ?—No, it was some water in the shot-hole, and when the shot went out it blew the stemming out.

14082. Then you do not think that could have been avoided ?—No, I think not.

14083-7. So that every now and then you must have a blown-out shot, and it is impossible by any rule to avoid it, even if the Rules are observed ?—That is the only blown-out shot I have known in the last 10 years.

14088. (*Dr. Haldane.*) With regard to your statement that he only danger from dust is on the main haulage roads in your own district, you, of course, would not apply that to other districts, would you ? You are quite aware that in Wales, for instance, explosions simply go everywhere through the face ?—Yes. I would not apply that to all places. I say there ought to be a difference between fiery and non-fiery mines.

14089. Well, that is not a difference between the fiery and non-fiery mines ; it is in regard to the dust.—I mean

Digitized by Google

Mr. John T. Todd.

Feb. 1907.

the hot dry dust they get in the fiery mines is much larger in quantity than it is in an ordinary mine like ours.

14090. For some reason or other, whatever it is, that statement of yours only applies to certain districts of England ?—Yes, that only applies to our own district, the Midland district.

14091. And, to some extent, the Northern districts ?—A little in the Northern ; but the bulk of the coal has been worked on the board and pillar system in the coal, and it is rather different to the long-wall system, because there you get grinding of coal on the roads. In the long-wall your entire roads are in stone, and any grinding of roads is stone, not coal dust.

14092. Then you think that the danger of an explosion spreading to near the face is greater with pillar and stall workings ?—I do.

14093. Can you point to any experience with regard to explosions which bears that out ?—I do not think I can.

14094. That is simply your impression ?—Yes—simply an opinion.

14095. It is the case, is it not, that in most explosions I should say—anywhere in England out of Wales—when an explosion does happen on a main road it stops before reaching the face, as a general rule ?—Yes, as a general rule it does. In Elemore it went right into the face in one seam, and killed some men who were in the act of loading coal in the trams.

14096. Was there evidence of a flame right up to the men ?—There was evidence of a flame right up to the men.

14097. And that was pillar and stall working ?—Yes.

14098. You do not think that would have happened on the long-wall system ?—Yes, it might ; it would depend upon where it occurred. It might go right into the face.

14099. Yes ; but you have already said that you do not think there was sufficient dust anywhere, except on the main haulage roads in your district, at any rate, to carry an explosion ?—Yes. I said it depends upon whether you get a large gas explosion.

14100. But a gas explosion on a main intake road occurs very seldom, does it not ?—Yes, it is very rare.

14101. I mean, to have enough gas on a main intake road to carry an explosion would be an extremely unlikely thing ?—Yes, it would be a rarity.

14102. There is no case which you can think of of that having occurred, is there ?—Have you the Seaham plan before you ?

14103. Yes, *this* is the Seaham plan.—Seaham was supposed to have originated with a shot.

14104. It was supposed to have originated with a shot but it could not have been a gas explosion, I think.—Also the bulk of the evidence tended to show that it originated at a fall in another direction altogether on the main road.

14105. Take the case of Seaham. I have the plan here which shows the exact distribution of the flame. The blue lines are the intake roads, and the dotted lines show the area of the flame, and you will see that the flame never extended to the face at any point, which bears out exactly what you say, but that it swept the whole of the haulage roads ?—Yes, but there were two opinions as to where that occurred. One was that it was a fall down one of these roads. and the other that it was a shot near the shaft.

14106. In either case it was a dust explosion, was it not ?—No, this was said to be a gas explosion.

14107. Yes, it may have started as a small gas explosion, but the extension must have been due to the dust ?—The dust largely helped. But in these pillar workings with goafs, which you have full of gas, there is also great probability of drawing the gas out of those goafs and carrying on a gas explosion.

14108. Yes, but it never occurred at any place where that source was possible : the explosion was confined entirely to the main intake roads which were swept by fresh air ?—That is so.

14109. Then even if an escape of gas had originated at the fall, which was supposed to have occurred, it would have only accounted for a local gas explosion ?—I quite agree that once you have an explosion started, dust is largely the carrier, the conveyor.

14110. Nearly all the records of these explosions in the North of England and the Midlands bear out what you said—that it is the main haulage roads which are almost the only dangerous places in the mine ?—That is so.

14111. Would you also say that if you could abolish blasting on the main haulage roads you would practically abolish the danger of explosions ?—No, I should not say that. You would abolish probably the danger so far as an explosion on a main haulage road is concerned.

14112. Yes, but assuming that there is very little danger of a big explosion elsewhere except a gas explosion, almost the only possible source of the big explosion is blasting on a main haulage road, is it not ?—I do not think so now. I think since the Explosives Order came into operation we have been very free from explosions caused by blasting upon main haulage roads where the regulations have been carried out.

14113. What other sources of explosions are there : what have there been ?—I have a list here of the accidents which have occurred recently : there was one in Scotland, at Drumpeller, in 1898, on January 28th, which was supposed to have been caused by gunpowder being taken down a main road.

14114. That was blasting, then ?—Yes, that was blasting with gunpowder—not a permitted explosive. At Merthyr on May 14th, 1900, there was an explosion by Bulldog powder, which fired gas, and there the evidence was that both the fuse was of a very bad type and that no precautions were taken at all as to watering.

14115. That was the case of an explosion in Wales ?—Yes. Then the one at Blaendare was the case of a naked light. The one at the Universal was with gelignite.

14116. That, again, is in Wales ?—I was going through the list. So that I think since the Order came into operation we have been wonderfully free from explosions caused by shot-firing on main haulage roads.

14117. But I wanted to know whether there is any other cause of explosion on a main haulage road which is of any importance ?—You may get it from a lamp. The MacLaren accident in Wales, for instance, was from firedamp, and there was no shot, and it was said not to be dusty. That was in September, 1902.

14118. Where did that explosion originate ; at the face, or where ?—It was from a damaged lamp, I think, and so also was the Cambrian.

14119. But in these cases the explosions originated at the working face, did they not ?—Yes, somewhere near the working face.

14120. And those cases are in Wales, where there is explosive dust everywhere, even in the returns, often ?—I do not quite know what question you wish to put. I will try to answer it if I can.

14121. I put this to you, that taking the districts which you are particularly acquainted with in the Midlands and North of England, the risks of an explosion are confined, on your own showing, to the main haulage roads ?—Yes.

14122. If so, what other source of explosion is there but blasting ?—None that I know of—on a main haulage road.

14123. That is the point : if you abolished blasting you would abolish altogether the chances of an explosion ?—We have abolished them in the Midlands, because we have not had them.

14124. No, you have not had them ?—What I mean is this : I think blasting on main haulage roads now is being reduced to a minimum. People do not blast upon main haulage roads if they can possibly avoid it.

14125. Supposing they did not blast at all during the shifts, would not that practically prevent the possibility ?—Yes. I see no objection to firing any shot on a main haulage road when the men ordinarily employed are out of the pit.

14126. Then of course only one or two lives at the most are exposed ?—Yes. I do not see any difficulty in that.

14127. But supposing you were to abolish blasting altogether on the main haulage roads, when the men are in the pit, you would be removing almost every possible chance of an explosion in the large class of mines to which you were referring ?—That is so.

14128. Now with regard to the Elemore explosion, you said it went through 200 or 300 yards of arching ?—Yes, I think roughly about that.

14129. Was it dry or wet in that case ?—The evidence which was given at the enquiry was this : this is a copy which I have from the manager's (Mr. Lishman) evidence before the Dust Commission in 1891. At *Q.* 2773 he was asked : "Would not the theory that you have just put before the Commission account for that explosion ?—*A.* I do not think so, because the seam in which it occurred was not a dusty seam. That

Digitized by Google

was stated by me at the inquest. *Q.* Mr. Atkinson, I see, says that the Elemore downcast shaft was 'exceptionally dry'?—*A.* I deny that. There were pumping operations going on in the shaft every week, and it was partially a wet shaft. *Q.* Do you think there was not dust enough?—*A.* There was not sufficient dust there to be raised. The floor was damp to begin with." I quite agree with that, because I knew the pit perfectly.

14130. It was more or less damp?—It was more or less damp.

14131. Then where could the dust lodge in that case?—In the roof.

14132. Do you mean sticking to the brickwork?—No. There were arching operations going on, and it was a continuation, a direct run from the shaft, and from the end of the arching there was a length of ground being prepared to put in more arching. A shot was put in the side sloping up towards the roof, and it was supposed that there was gas up in that roof, and dust together, and that it fired there; it was a blown-out shot.

14133. But I want to know how the flame got through the arching?—I do not know. It went right to the surface.

14134. Probably there was some dust in that arched piece of road?—There may have been: but the floor was damp. Of course in reaching the shaft it had to traverse the shaft siding where loaded trams were standing; there might be a certain amount of dust there: but the flame went right to the surface.

14135. Was the flame seen at the surface?—The flame was seen at the surface, and it blew all the flat sheets at the top of the pit and all the head gearing wrong. Have you the Elemore plan? If so you will find exactly the same thing from the plan—that in getting to the face the explosion stopped a certain distance from the faces.

14136. I am afraid I have not the Elemore plan. So that you do not feel at all confident that a dustless zone in a mine would stop an explosion?—I should not like to express an opinion that it would. I think the point as it was put by one of the Commissioners previously is the right one, that the less the dust the less would be the danger. But I should like to see some authoritative and definite experiments to test the other point, from experiments made by a combination of the Home Office, the mining engineers of the country, and representatives of the workmen.

14137. One further point with regard to the trams. You are pretty clear that the trams with open ends are not a very great disadvantage as regards dust?—I do not think so, with us. As I said before, a large portion of our coal is large coal, which is loaded by hand, and it does not make very much dust.

14138. But I suppose you would admit that in other collieries it might be quite different?—Yes, but they have different trams, I think; I think they have trams to suit each district. For instance, the trams in Wales may be very different from our trams, and the trams in Scotland may be very different from ours. The trams might be made to suit the different districts in which they are working.

14139. Some witnesses have laid great stress upon the importance of having close tubs?—I think Mr. Fowler has boxed-in tubs, or something of the sort.

14140. You think that as regards the coal of which you have chiefly had experience it would not make very much difference?—I do not think so.

14141. But there is a good deal of dust in your mines, is there not? Where does that come from?—There is a certain amount of dust, of course: the bulk of it is from the grinding of the sides and roof. In long-wall working nearly all your roads are in stone, and there is a certain amount of grinding which goes on from that, and there is also a certain quantity of dust made from coal which may be blown off or which may fall off the trams and be crushed up.

14142. But I am referring to the coaldust which is on the main haulage roads; where does that come from?—That is very fine dust which is blown off the tops of the trams chiefly.

14143. You think that is not dust from pieces of coal which have fallen from the trams or through the interstices of the trams?—Yes; I say there may be small pieces of coal which fall off the trams and may eventually become ground up in the bottom, and there may be dust ultimately from that.

14144. But you do not think that is the chief source of dust?—I do not think so. I think it is chiefly dust blown off the tops of the trams in our case, and fine dust that may be made from the sides, which may become stirred up and blown about and then deposited.

14145. Is there any objection to watering the trams on each journey before it starts?—I do not think you could do that; you do not want to have wet coal on your screens, or you will clog up your screens.

14146. I think the last witness who gave evidence before us said that it did not matter—that his practice was to wet the coal?—If the coal did absorb all the moisture you might water it very much. Many coals are very dry, and if you take a large number of the analyses of Welsh coal and North of England coal you probably will not get more than ¾ per cent. to 1 per cent. of moisture in them. If you take our coals, as I have said before you get from 5 per cent. to 7 per cent. of moisture in the coal itself, so that it is not a dry coal; and that, with the low temperatures, as I say, tends to make it very different from a very dusty coal in a very hot mine, with regard to depositing.

14147. To come back to the question of timber rotting have you ever seen a mine in which timber is really kept constantly damp either by the stagnation of the air or from any other cause?—I have seen it where it is kept damp by the wet nature of the mine.

14148. Do you think that that timber goes more quickly?—It does. We have one pit in which we have a very large quantity of water, and that timber rots very quickly.

14149. You are aware that they water the timber and everything constantly in Germany?—Yes.

14150. And they do not complain there of the timber rotting?—I do not know what their conditions are.

14151. In Cornish mines, where the timber is always wet—the whole mine is saturated as a general rule—timbers last wonderfully well, so far as I have seen?—That may be so.

14152. It seemed to me that it was where they were dry that they began to go?—That is not my experience.

14153. (*Chairman.*) With regard to these trams, I understand you to say that the fourth side is planked in after the coal is put in?—Yes, there is a loose end put in.

14154. And that loose end is fairly dust-tight?—Yes.

14155. You have four sides that are fairly dust-tight?—That end is not to the full height of the tram; it is perhaps half the height, or not quite half.

14156. Therefore, some dust does tumble out?—There is a little coming out, perhaps.

14157. You do not think that is objectionable?—I do not think so.

14158. (*Mr. Smillie.*) I suppose the question of the timber rotting or standing depends largely upon the nature of the timber?—Yes.

14159. Fir, for instance, will not last as long as larch?—No.

14160. You might have a roadway timbered with larch which will stand for years without requiring renewal?—Yes, I do not deny it.

14161. What is the nature of the floor of your workings: is it good floor?—No: it is a sort of what we call segar clay: it is of a clayey nature.

14162. You have about 3 ft. of blue bind for the roof in one seam?—Yes.

14163. You have sandstone rock in others?—Sandstone rock in others.

14164. Your blue bind would stand very well if you did not rip it for your roof?—Yes.

14165. Would it stand watering if it was not ripped at all?—No.

14166. Have you in any cases taken your roadway out of the bottom and left your blue bind on?—Yes: we tried that in one pit for that very reason—not to break through the blue bind to the bad stone.

14167. I was going to suggest that your blue bind would stand far better than the 15 ft. you have above it?—Yes, we tried that: we found that the cure was worse than the disease.

14168. Did you suggest 1½d. per ton for the cost of watering on your present system of watering?—No, I suggested that 1½d. per ton would, as I thought, be about what it would cost for piping.

14169. Was that to water zones, or to water the whole of the main roadways?—To water the whole roadways.

Digitized by Google

Mr. John T. Todd.

21 Feb. 1907.

I agree that about 1½d. per ton would be the cost of watering the whole of the main roadways.

14170. Of course, you would admit that if you had only two zones in, say, 2,000 yards of roadway, the cost would be considerably reduced for watering those two zones?—Yes, it would be very small. That is why I do not see the object of laying pipes if you have only got a small zone to water.

14171. You can really do it cheaper by taking the water in?—Yes, you can do it cheaper in that case by taking the water in another way.

14172. I think you suggested that extensive watering would be a source of danger by encouraging spontaneous combustion, did you not?—Yes, in some collieries where they are very liable to spontaneous combustion.

14173. I think at the present time you put, in some cases at least, nearly all your small coal into the gob?—Yes.

14174. Is that not a very serious danger?—No, it is not with us.

14175. Have you had no gob fires?—We have never had one. It has been done for the last 30 years or more.

14176. If you were troubled with gob fires, it would be a more serious source of danger than the other?—Yes, of course it would.

14177. But the fact that you do not send out your small coal must clearly tend to keep your roads more free from dust than they otherwise would be?—That is so.

14178. You are aware that in some parts of Wales, the North of England and Scotland, they send out all the dust?—Yes.

14179. And sometimes it is very very fine dust?—That is so.

14180. In cases of that kind the make of the tubs is a very important matter?—Yes.

14181. If they are open at the sides and the bottom, then the small dust is likely to fall out on to the roads?—Yes, it will fall out.

14182. It would be a very considerable improvement to have dust-tight tubs in cases of that kind rather than open tubs?—Yes. We call ours fairly dust-tight; in fact, we call them dust-tight tubs. Although they are not absolutely dust-tight, they are as far as possible.

Mr. JOHN NEVIN, called and examined.

The Witness handed in the following Statement:—

Mr. John Nevin.

14182a. (1) I consider that any classification of dusty and non dusty mines would be very difficult.

(2) The most explosive class of dust is that deposited on projections on the sides and on the timber of haulage roads. I believe no explosion of dust has been traced to a naked light except in one case which was in a coal bunker at the surface. Generally, in mines, sufficient heat and disturbance of the dust must have been caused by a slight explosion of firedamp or shot-firing to cause a serious explosion.

Dust is more or less inflammable.

(*a*) as it consists of a more or less carbonaceous matter.

(*b*) in proportion to its mechanical fineness.

(3) The most explosive dust is found on the haulage roads and not at the working faces, where it is so much coarser.

(4) (*a*) Dust can rarely be blown into an intake haulage road from the working faces, as from there it would be taken towards the return by the air current.

(*b*) A certain amount will escape through crevices in the tubs.

(*c*) A certain amount will be blown from the top of the full tubs drawn against the air current.

(*d*) If the screens are near the downcast shaft, without special precautions some dust will go down the downcast shaft. I have no other sources to suggest.

(5) (*a*) Most of the wagons in West Yorkshire are fairly tight, but some might be improved.

(*b*) Covering the tubs is impracticable.

(*c*) *Spraying Journeys.*—If coal be watered at the face before or after being filled into the tubs it will cause great trouble in screening the coal when it arrives at the surface, and increase the liability to spontaneous combustion if the coal be stacked or put in large cargoes into a ship's hold.

(*d*) In new collieries the screens might be placed away from the downcast shaft, but in old ones this is impossible, but part of the dust may be collected by fans, &c.

I am of the opinion that in deep and hot mines it is not possible to prevent accumulation of dust entirely.

(6) I think a rule making watering universally compulsory would be impracticable. I know, personally, many cases both in South and West Yorkshire, in which universal watering would cause the closing of the pits. The roof, floors and sides in most collieries are of shale, which originally has been laid down under water in the shape of mud, and which remains solid when dry, soon going into the original state of mud when exposed to the action of water assisted by high temperature and pressure.

The simple fact of watering the floor of the roads is not sufficient to do away with the danger arising from dust. I have not had much experience in seeing the state of pits after a dust explosion, but in the few cases I have seen I found coked dust chiefly on the sides and on the timber, showing that the danger has arisen from the fine dust deposited there more than from the coarser dust on the floor.

I believe it is a fact that no explosion from dust has arisen where the present rules as to gas and shot-firing have been adhered to. The accidents that have occurred have been due to breaches of these rules.

I think there is no doubt that universal watering would increase other accidents. In going over the returns of fatal accidents for eleven years, from 1896 to 1906, I find the total deaths from explosions of firedamp or coal dust have been 774 or 70·37 per annum, while those caused by falls of roof and sides have been 5,340 or an average of 485·45 per annum. In the same period the haulage accidents have caused 2,057 deaths or an average of 187.

Watering to be effective would not only have to wet the floor, but also thoroughly wet the roof and sides. This is very difficult to do. I know many collieries in which such watering would cause extremely serious damage from falls, and would also increase the danger of haulage accidents by derailing and collision, and I am sure that were watering of the main roads to be universally compulsory, many of the largest collieries in Yorkshire would be unworkable.

I think that certain lengths of road by arching or otherwise might be kept free from dust, and so tend to limit the effects of an explosion, but what lengths of such arching would be necessary I am not prepared to say.

(7) The addition of salt to water used for damping the roads has been found very useful.

I do not think that sprinkling non-inflammable dust is practicable or advisable.

(8) As to practical methods of preventing danger, I consider that stricter rules as to shot-firing in main roads may be of use.

I consider watering as carried out in Germany, is impossible in most of our mines.

I should suggest that before any legislation take place or alterations to the present rules be made, that further exhaustive inquiries as to the character of different dusts and the true cause of dust explosions should be instituted, and that a series of experiments should be carried out as has been done in the case of safety lamps and explosives.

I deprecate hasty legislation, and I am afraid the endeavour to minimise the danger of explosions, may

Digitized by Google

increase a much more frequent danger arising from falls and haulage accidents.

14183. (*Chairman.*) You are a mining engineer and colliery owner, a Fellow of The Geological Society, and a Justice of the Peace for the West Riding of Yorkshire, and you are Past President of the Midland Institute of Mining, Civil and Mechanical Engineers, and a member of The North of England Institute of Mining Engineers, and you are also President of the Yorkshire Branch of the National Association of Colliery Managers, and a member of the Mining Committee of The Leeds University, and you have had 39 years' experience, chiefly in the West Riding of Yorkshire, and in various other parts of England, and have visited collieries in France, Belgium, Westphalia and the United States. You say your experience has been chiefly in the West Riding of Yorkshire ?—Chiefly in the West Riding of Yorkshire.

14184. And in various other parts of England. What other parts of England have you had experience of ?—I have been at various times in most of the coalfields in England, in North and South Staffordshire, Nottinghamshire, Derbyshire and most of the English coalfields.

14185. I suppose you have been down the pits ?—Yes.

14186. And you know something of the practical working of coal mines all over England ?—Yes.

14187. What about Wales ?—Wales I really know nothing about.

14188. Have you visited all sorts of coal mines in France, Belgium, Westphalia and the United States ? What has been your experience in these countries ; for instance, take France ?—I have been down some of the collieries in the North of France.

14189. Of the same kind ?—Yes, the collieries next to the Courrières. I have been down the Hibernia in Westphalia, that is the only one ; and in the States I have been into several in Ohio and Alabama and West Virginia.

14190. Have you had experience of different kinds of mines, dry and dusty mines, fiery and wet mines, and mines which are not so in the United States ?—In the United States their mines, compared with ours, are very elementary. They are most of them entirely water free, and they are damp, but they are not deep enough to be dry and dusty.

14191. So that there is no difficulty in the mines you have seen in the United States, nor danger in working them ?—They are where we were 100 years ago, or more.

14192. Have you been into many of the mines in Belgium ?—No, I think two in Belgium.

14193. Of what character ?—They were deep and warm.

14194. You have been asked to give evidence by the West Yorkshire Coalowners' Association and The Midland Institute of Mining, Civil and Mechanical Engineers. Those are the persons who have asked you to come here ?—That is so.

14195. With regard to Paragraph 1 you think that any classification of dusty and non-dusty mines would be a very difficult thing. You would not know when to draw the line between a mine which was considered dusty and a mine which was considered non-dusty ?—I think that is so.

14196. You have no difficulty in saying a great many mines were dusty and a great many non-dusty, but the difficulty would be that there would be an intermediate class of mine which some people would call dusty and some non-dusty ?—Yes, or it is possible one part of a mine might be dusty and another part damp.

14197. Then you talk about the most explosive class of dust. When you talk about explosive dust do you consider that dust can be exploded by a naked light, or do you think that there must be some force used, such as a blown-out shot, in order to ignite the coal dust ?—I think there must be some force used. I do not know of any explosion which has been traced to an open light except the one in a bunker at Brancepeth, where they were sweeping dust from some of the beams and the man was there with an open light and an accident happened. I do not know one in a colliery which can be traced to an open light.

14198. You do not think those conditions which caused the coal bunker explosion could take place underground ?—I think not. I do not think any case has taken place underground.

14199. The most explosive class of dust is that deposited on the projections on the sides and on the timber of haulage roads. That you consider more explosive than the dust found on the floor ?—Yes.

14200. I suppose that it would be more explosive for two reasons : first of all, because it probably would be finer dust ?—Yes.

14201. In the second place, it would be purer ; it is more carbonaceous ?—Yes, probably the coal dust being lighter than any stone dust, the dust on the timber and the sides is mostly coal dust pure and simple.

14202. Have you ever made any experiment with a view to testing how far the admixture of non-inflammable matter would render coal dust unexplosive or uninflammable ?—No, I have not.

14203. Sufficient heat and disturbance of the dust must have been caused by a slight explosion of firedamp or shot-firing to cause a serious explosion. Then you say dust is more or less inflammable, as it consists of more or less carbonaceous matter, and also in proportion to its mechanical fineness. Are those two general propositions generally agreed to ?—Yes.

14204. With regard to the amount, you have nothing you can say to the Commission ?—No, I have never made any experiments. I cannot say at all.

14205. Then you say, and I think most people agree, that the most explosive dust is found on the haulage road, and not at the working face, where it is so much coarser. Is not there another reason, that the explosive dust does not come there in such great quantities ? There is not so much dust at the working faces as there is on the haulage roads ?—No, I do not think one can say that.

14206. You think not ?—I think not.

14207. There is a good deal of dust on the haulage roads shaken out from the trams. You cannot help that, I suppose ?—With us, with closed trams, there is comparatively little.

14208. I think it is generally suggested that the haulage roads not only claim the finest and most explosive dust, but a great many of the witnesses are prepared to think that the nearer you get to the face the less dust there is. You do not agree with that ?—I cannot quite agree with that.

14209. Then you give the ways in which dust would accumulate, and you acknowledge that a certain amount will escape through crevices in tubs. That is necessarily so ?—Yes.

14210. Then a certain amount, you say, will be blown from the top of the full tubs drawn against the air current ?—That depends very much, of course, on the method of haulage. If you have slow endless rope haulage, anything from one to three and-a-half miles an hour, you will not get much ; but if you are drawing against the air ten miles an hour, as you do with a tail-rope system, you will get it.

14211. Then you mention the dust from the screens. If the screens are near the downcast shaft, you say without special precaution some dust will come down the downcast shaft. What special precautions do you suggest as regard the screens ?—The best precaution I know of for screens near the downcast shaft has been taken at Cadeby Colliery, where they have enclosed their screens and put in fans to draw the dust into a chamber.

14212. You think that is a good plan ?—I think it is, decidedly, because a certain amount of dust will come off the screens. You cannot help it. If near the downcast shaft some will go down the downcast shaft.

14213. How far from the downcast shaft ought the screens to be to prevent any dangerous amount of dust going down ?—That is a difficult thing to say. That would depend on the coal and the prevailing winds, and so on.

14214. Thirty yards has been suggested as being a reasonable distance ?—That would be quite near enough, I think, for a dusty coal.

14215. Suppose a new pit is opened, you can put your screens where you please. Do you think there ought to be some regulation to forbid the screening too close to the down-cast pit ?—Unless you have some means of taking the dust away, as at Cadeby they had, I think so. If I were putting down screens for a dusty pit, if I did not provide something of that sort I should certainly put them 100 yards away.

14216. You would put them at least 100 yards away ?—Yes, with the present system of shaking screens and belts, because you get much more dust than you did with the old screens. I find now since we have put down shaking

Digitized by Google

Mr. John Nevin.

21 Feb. 1907.

screens and belts we get much more dust flying about than we did.

14217. That is a reform the wrong way. It has a tendency to take more dust into the mine ?—Decidedly, to have more dust flying about, part of which would go down the down-cast shaft with the air.

14218. Would you be in favour of preventing dust going down by any system of spraying, so that the dust should be precipitated in a damp state ?—No, I do not think that could be done.

14219. You say about the wagons in West Yorkshire that they are fairly tight, but some might be improved, and that there are different types of wagons in use ?—I simply mean this : most of the wagons in use in West or South Yorkshire are made of wood, and you can probably tighten them where the boards join ; at present they are simply end to end. I think, by tongueing or grooving, or things of that kind, you can make them tighter than they are now. However tight you make a corf they will shake loose.

14220. In some cases steel tubs are used and are found to be better ?—I think steel tubs will have less dust falling through than wooden ones.

14221. I fancy the steel ones are driving the others out in Yorkshire ?—I think they are—in a dry mine, but in a wet mine where you water from the roof the steel tubs will not last as long as the wooden ones.

14222. Do they rust ?—Yes, I have found that. I have both wood and steel tubs, and the advantage of the steel is that you get a larger content of the tub for the same outside size ; but I found that they are more expensive to keep in repair than the wooden tubs.

14223. If a mine is dry and the tubs do not get much watered, then you prefer the steel ?—Then I prefer the steel.

14224. As being more economical ?—The main reason is that you get a larger amount of coal out in one tub than you do with a wooden one.

14225. They are better ?—Supposing the tub is the same size outside : with steel you have got one-eighth of an inch thickness of sides ; with wood you have more than one inch. Therefore the difference is as a 5-cwt. tub is to nearly a 6-cwt. tub, with the same outside size.

14226. Are your tubs covered in all four sides ?—Yes.

14227. How do you load them ?—We load them from the top.

14228. You find the men do not object to that ?—No ; our coal is a gas coal, and gets into small pieces. We have no difficulty in loading the tub. The tub drops off the end of the rails in the face and leaves a space of 6 or 8 ins. between the tub and the roof. There is no difficulty in loading it. In steam coal, or coal which gets in large pieces there is a difficulty.

14229. To cover the tubs is impracticable ?—I think so.

14230. Do you think if you were to forbid the tubs being loaded above the sides that that would decrease the dust at all ?—I do not think so, to any great extent. It is very difficult to do with coal getting in large pieces.

14231. With regard to spraying you say that there would be great difficulty in that because it would cause great trouble in screening the coal when it arrives at the surface. Some witnesses said the opposite. They said a certain amount of damp is a good thing, but they do not like the coal to be too dry and dusty at the screen, but a slight amount of damp helps them ? A slight amount might, possibly, but if you get too much, especially with the present screens, which are chiefly screens with round perforations, you very soon get those perforations made up with a wet coal, and then you have difficulty ; if you come to stack wet coal you are very liable to get spontaneous combustion, or putting a large cargo into a ship.

14232. That is what you say, but have you known of an instance of spontaneous combustion ?—If we stack a certain amount of gas coal—a heap of 2,000 tons—we have to be very careful ; we have to keep iron rods in and watch.

14233. Have you had any accidents in the way of spontaneous combustion ?—More than once we have had a coal stack getting on fire.

14234. To get spontaneous combustion you must have a very large amount of coal—you say a stack of 2,000 tons ?—That is nothing like the load of a big steamer.

14235. You say in the deep and hot mines that it is not possible to prevent entirely an accumulation of the dust. Then you deal with the question of watering, and to some extent with the question of dust-free roads. I suppose you consider that the watering is much more effective when it can be done than any system of sweeping up the dust would be in the way of checking explosions ? —Yes. I am afraid sweeping out the dust entirely would be very difficult.

14236. Have you done much sweeping in your mines ? —No ; in our mines we are pumping about 1,000,000 gallons of water a day and, therefore, the dust question does not arise. That is as far as I am personally concerned. Of course I know a lot of the collieries which are both hot and dusty.

14237. You only speak from experience of mines which you have casually gone down ?—Yes, that is so.

14238. You do not speak of mines you are absolutely familiar with from day to day ?—No ; in the mines I am familiar with from day to day the dust question does not arise. I have been into many of the deep and hot mines in both South and West Yorkshire—I have been pretty well through them on various professional business, and I am acquainted with them in that way.

14239. Then you lay down rather a strong proposition. You say you believe it is a fact that no explosion from dust has arisen where the present rules as to gas and shot-firing have been adhered to, and that the accidents that have occurred have been due to breaches of these rules—without exception, that is to say ?—I think so. I think in every case of a heavy dust explosion it has been from shot-firing when proper precautions have not been taken.

14240. Have you had any accidents in your own mines that you are familiar with ?—Not from dust.

14241. None at all ?—None at all.

14242. You only speak from your general knowledge of other mines and what people have told you and what you have read from time to time—accounts of accidents ? —I have been down several mines after explosions. When it has been a dust explosion there are pretty clear traces of it.

14243. In every case where you have been down a mine after a dust explosion you came to the conclusion that the explosion has been due to some breach of rules ?—That is so.

14244. You say that without exception ?—I think that is so.

14245. It is rather a strong proposition to make. I suppose you have carefully gone into every one of the cases where you have explored mines after an explosion, and you have definitely come to the conclusion in every case in all probability ?—That is the conclusion I have come to in any case upon which I can speak from my own knowledge ; of course, I cannot say it is so in every case that has happened.

14246. We are aware that falls of roofs and sides account for a great many more accidents than explosions, but at the same time there is this about accidents from explosions, that there is a possibility where there is a great deal of intercommunication underground that there may be some very terrible explosion, like Courrières, which will bring up the death roll enormously. You say watering to be effective would not only have to wet the floor, but also thoroughly to wet the roof and sides at the same time, and I imagine that you would agree that to water thoroughly the floor would have some stopping effect probably on explosions ?—It might have some, but I think the dust that causes a dust explosion is the dust which is on the sides, the finer dust on the projections of the sides and the roofs, and the timbers especially.

14247. Some of the witnesses have said that if you water the floor any considerable length, that from time to time the ventilation would cause the dust to get into the air from the props and sprags, and in that way if you watered the floor the finer dust above, some of it, would naturally, by gravity, settle on the floor, and directly it settled on the floor it would be wet and become harmless, so that if you wet the floor to some extent you diminish the amount of dust above ?—It would have a tendency to do so. Any dust that falls off and settles on the floor would be damped.

14248. You do not attach much importance to the small amount of dust that, in your opinion, could be dealt with by watering the floor ?—No, I do not.

14249. Compared with the dust above ?—No.

14250. You say watering in many cases would cause extremely serious damage from falls. Do you mean simply damage to the working of the mine or damage to the life of the colliers ?—I mean damage to life and limb.

Digitized by Google

14251. What experience have you had upon which you form that opinion?—Well, I know cases, especially in South Yorkshire, where the mines are deep and hot, and where, if you throw a bucketful of water against the side you will have the dirt coming off in a very short time. Of course I am giving you this from what I may call hearsay evidence; you will probably have Mr. Chambers of Denaby before you, and he will tell you the experiments he made in the presence of one of the inspectors.

14252. Perhaps it will be better to get that evidence from him?—Yes.

14253. You say it will also increase the danger of haulage accidents by derailing and collision?—Yes. If you water a road which is soft bind you will have, during the course of the day, pieces of side or roof, if you water the roof, falling off, and those will interfere with the haulage and will fall on to the road, and you will have sets of corves off, and those are liable to knock the timber out and you may have serious accidents.

14254. In your own mines have you known many accidents caused in that way?—Yes, we have regularly accidents caused in that way from pieces of sides or roof falling on to the road.

14255. I fancy the greater part of the haulage accidents are due to the breaking of the haulage rope and the trams or tubs getting free and running back, like the accident the other day, and also from carelessness of the men or boys in riding upon the tubs when they ought not to, or something of that sort?—That was a man walking out on a haulage road; if the set gets off the road he may be caught and damaged in that way. I think more accidents happen from corves being derailed than from any breakage of ropes.

14256. You have information, and it is a constant danger that falls from the roof and side may derail trucks?—I think that is so. Taking our collieries, which are small ones, still we have something like 12,000 yards of haulage road, and I do not think there is a day passes without some derailment or something happening, or pieces falling off the side or the roof.

14257. Then you come to the question of watering in zones. You say that certain lengths of road might be kept free from dust by arching, or otherwise. I suppose you will say that the roads must be arched or concreted in some way in order to effectually get rid of dust, if you do not water?—Yes.

14258. You have made no experiments as to the length of arching that will be necessary?—No.

14259. You are probably of opinion, I suppose, that a dry and dustless zone must be longer than a wet zone?—Yes, I think that would be so.

14260. Then you say that the addition of salt to water used for damping the road has been found very useful. We have had some evidence about that, and some of the witnesses before us have told us that salt is no use at all. You do not agree with that?—I cannot speak practically. I can only speak from hearsay evidence in that case. I know some people are very much in favour of salt, and some are not.

14261. You have no personal experience to go by?—No, I have not.

14262. You go on to say that you do not think the sprinkling of non-inflammable dust is practicable or advisable. The suggestion is made by Mr. Smillie that it might be a good thing to remove the dust by a sand blast, so that the dust would be mixed with the sand, and the question is whether the dust would be mixed with the sand or whether the sand would not somehow or other get through the dust and fall to the ground without being mixed?—That the lighter dust would rise to the surface?

14263. Yes?—And the heavier dust would sink.

14264. You have not made any experiments?—No; I am afraid I cannot express any opinion as to that.

14265. You say that more strict rules as to shot-firing in main roads may be of use. What do you suggest as to more strict rules with regard to shot-firing?—It is rather difficult to say. When I wrote that sentence I had in my mind the accident which happened in Durham a few months ago, where a man fired a most foolish shot in the middle of a haulage road, with the result that we know.

14266. How do you mean "a foolish shot"? Did he commit a breach of the rules in firing that shot?—He put an unstemmed cartridge of explosive on to what they call a canch on the roadside, and fired it, and the result was he fired the pit

14267. Was he authorised by the manager to fire the shot?—No.

14268. Do you think in all cases of firing shots on haulage or main roads that the manager ought to authorise each particular shot to be fired?—I do, with the knowledge we have now of dust explosions. I think so decidedly.

14269. You think that before the manager authorises the shot to be fired that he ought, at all events, very recently, to go down and see exactly the position in which the shot proposed to be fired is to be placed?—Yes, I think so.

14270. Would you go so far as to say that he ought himself to superintend the operations?—No, because a manager of a large mine ought to have other people under him quite capable of doing so.

14271. He ought to depute somebody to see where he thinks the shot ought to be placed, and carry out instructions?—Yes, and to see proper precautions as to watering are taken.

14272. And no shot-firing except by special men deputed to do so?—I think in most collieries that is so already. Taking our own place, no man is allowed to fire a shot unless he has an authority.

14273. In your opinion it is not necessary that the authority should come from the manager himself as regards each particular shot, only a general authority to fire shots?—A general authority to fire shots.

14274. You think before any legislation or alterations to the present rules are made that further exhaustive enquiries as to the character of different dust and the true cause of dust explosions should be instituted, and that a series of experiments should be carried out, as has been done in the case of safety lamps and explosives. I suppose you would say that in order to be of much use experiments should be carried on as far as possible under the same conditions that obtain underground?—Yes.

14275. For instance, to test the effect of a length of a wet or dry zone stopping an explosion, you must have something in the nature of a long tunnel?—You must have a long length of experimental gallery, and experiment with various kinds of coal dust and various modes of igniting it.

14276. (*Mr. Cunynghame.*) One of the previous witnesses told us that a good position for these isolating zones would be at the end of the main haulage roads in-bye, to isolate the haulage roads?—From the inner workings.

14277. Do you agree with that?—No. My own opinion is that the best place would be at the junction of various roads. I do not think it is much good at the in-bye end. As far as my knowledge goes of a dust explosion you very rarely find the men at the face are burned; they are killed by the afterdamp which has gone in-bye with the current. An explosion travels out against the air.

14278. The question is where the explosion originates. If it originates more in-bye than the end of the main haulage road, then an isolating band would protect the main haulage road from the effect?—Yes, I see the argument. I have not thought of that before.

14279. What do you think of it now, having heard the argument?—I think that there is a great deal in it. The difficulty is where you are to put your zone when your various workings branch off your main road.

14280. I am not only suggesting that there should be a zone there, but in the main haulage roads at certain intervals, and preferably of course at junctions, there should be others too?—Yes.

14281. You think that would be a sensible way of doing it?—Yes.

14282. Provided the distances and positions were arranged?—Yes.

14283. That is not unreasonable as a general rule in the majority of mines?—I think that would not be unreasonable, but I see difficulties.

14284. Although in certain mines there are difficulties which might have to be dealt with in other ways?—Yes.

14285. (*Mr. Ratcliffe Ellis.*) There are cases, are there not, where from the conditions of the strata of the mines you could not water?—Certainly.

14286. In order to get rid of the dangerous character of the dust you would have to adopt some other system?—Yes.

14287. In your opinion, could you sufficiently clear an ordinary road from dust so as to prevent the consequences of an explosion extending, if there was an explosion, unless

Digitized by Google

Mr. John Nevin.

21 Feb. 1907.

you specially prepared the road by arching it ?—I think that it might be possible to prepare the road otherwise than by arching it. I know some collieries where it is extremely difficult to get arching to stand, where it has been put in two or three times and always crushed in. I think it might be possible to prepare a length of road without any arching.

14288. First of all, do you think it possible to clear an ordinary road sufficient from dust without some special preparation of road ?—No.

14289. What special preparation other than arching do you think is practicable ?—I think that it might be possible to cement the sides to make a smooth side.

14290. What about the roof ?—The roof in the same way would have to be done. In these pits I am thinking about where arching will not stand you would have the same difficulty with any mode of preparation. You might get something which would make your sides smooth at less expense than putting in arching.

14291. There would have to be some sort of preparation ? —There would have to be to make a dust-free part.

14292. What about the distance and length of these zones you mention ?—I cannot express an opinion.

14293. As to watering and as to being dustless ?—I cannot express an opinion.

14294. In cases where neither the one nor the other is practicable have you any suggestion to make as to what can be done there ?—No, I have not. If neither preparing the road nor watering is possible, I have not a suggestion to make, except to limit as far as possible the sources of the dust.

14295. There are two things to do ; first of all limit as far as possible the sources of the dust to get rid of it as far as you can, and to have the regulations as to shot-firing stringent ?—Yes.

14296. And carried out ?—Yes, to limit as far as possible the source of the dust, and to limit as far as possible any source of inflammation.

14297. That would be the third alternative where neither the one nor the other was practicable. Now you say that it is difficult to classify dusty and non-dusty mines. What do you suggest as the classification of fiery and non-fiery mines. If you take the Explosives Order, for instance, it says :—" In all coal mines in which inflammable gas has been found within the three previous months in such quantity as to be indicative of danger." Would that define in your mines a fiery mine as distinguished from a non-fiery mine ?—That defines a fiery mine as distinguished from a non-fiery mine. The difficulty is rather to define what is a dangerous amount of dust and what is not.

14298. A dangerous amount of inflammable dust you mean ?—Yes.

14299. Can you suggest any definition between one and the other ?—No, I am not prepared to do that.

14300. Would you treat them differently with reference to the subject we are discussing of these zones ?—That is a question upon which I cannot express an opinion.

14301. At the moment, as far as your judgment has been formed, would these precautions you have mentioned apply to all mines ?—I do not think so.

14302. What do you say about the German system of universal watering ?—I understand that the system is not universal, but that a great many of the mines are exempt.

14303. That is so ?—Although nominally every mine has to be watered, in practice I understand a great many are not.

14304. (*Dr. Haldane.*) Certain seams are exempted ?—I cannot say whether certain seams or certain mines, but I understand that there are a great many exemptions.

14305. They define in the regulations certain seams which are supposed to be safe, and which are supposed not to make any dangerous dust ?—Yes.

(*Mr. Ratcliffe Ellis.*) Those are exempted.

(*Dr. Haldane.*) Those in practice are exempted.

(*Chairman.*) Not simply on the ground that the strata are such that it is almost impossible to water them.

(*Dr. Haldane.*) No, there is another possibility of exemption for a reason quite independently of whether the seams are dangerous or not.

14306. (*Mr. Ratcliffe Ellis.*) Now, as to the sources of the dust. In your experience is there much dust at the face of a dangerous character ?—There is in some mines a good deal of dust at the face, but I do not remember an explosion ever having been traced to dust at the face. I may be wrong, but as far as my memory serves me I do not remember having an explosion happening from dust at the face.

14307. How do you consider the dust arises on the main roads. Where does that come from ?—That must come from the tubs in course of transit. That is the only way it can come. Where, as a rule, the main roads are the intakes, because any dust in the intake will be taken by the current to the return. There are cases where the return is the road, and then you get both dust and heat.

14308. Do you think the quantity that goes down a shaft is a considerable quantity ?—I am afraid that it is in some cases.

14309. It is sufficiently considerable to require attention at any rate ?—Yes.

14310. Would it be prevented if you raised the sides of the pit up ?—I cannot say ; I do not know how the dust will rise.

14311. Has that occurred to you as a way in which the matter might be dealt with ?—It had not occurred to me.

14312. It would be easier to do that than removing the screens ?—Yes, it would.

14313. Now as to shot-firing. At your own colliery you have, of course, a competent person to fire the shots ?—Yes.

14314. In the shots at the face, who drills the holes ?— In our case we have practically no shot-firing at all in the coal : the only shot-firing is in the ripping, and therefore the men who fire the shots practically drill the holes.

14315. And charge them ?—And the chargeman of each shift has leave to fire the shots.

14316. With the exception of the suggestion that no shots should be fired in a main road except with the sanction of the Manager, is there anything else in the shot-firing regulations that you think might be altered with advantage? —No, I do not think that there is if they are properly carried out. Of course we know there are many cases where the best of rules are made and some men foolishly do not carry out what they are told to do, as in this case in Durham the other day.

14317. (*Mr. Wm. Abraham.*) Have you had in your collieries any experience where watering has caused serious damage from falls ?—Yes, I have many a time whenever we get any place which for any reason gets full of water and we have to make a new—

14318. I do not mean from natural water, but where you have been watering for the purposes of health. Have you had any experience of falls from that cause ?—No, in our own collieries we have no need of water.

14319. In your own collieries you have had no experience of that ?—No, that is so. I may say what will, perhaps, be to the point. We have steam down the shaft, and if we have any leakage of steam we get tremendous falls directly—if I say heavy falls I am wrong, perhaps, but we get perpetual small falls in summer as soon as the temperature of the pit gets below the temperature of the surface air, and the moisture condenses on the sides and roof, and we have endless trouble with falls—every summer for three months, in the hotter weather in summer.

14320. That is caused by a change of the atmosphere ?— The warm air on the surface carries more moisture and condenses on the cold sides. You can take your hand and wipe the drops off. Then we have a bother with the endless haulage. If the moisture of the air will do that, I am perfectly certain that the moisture of the hose pipe would do it.

14321. That is from natural causes ?—That is from natural causes.

14322. You have had no experience of it from actual watering ?—No.

14323. Have you had any experience of derailing and collisions being caused by watering in your main roads ?— Not by the watering, but by the moisture when it condenses, on the roof and sides. We have it every year.

14324. The same as the other ?—Yes.

14325. Supposing watering the main roads in your colliery were made compulsory, are you of opinion that you would have to close those collieries ?—That would entirely depend upon what price we could get for our coals.

14326. Would they be unworkable at a price ?—At the ordinary price of the last ten years those collieries could not be worked if all the main roads are to be watered.

14327-8. Could not be worked at all ?—No, they could not be worked at a profit.

Digitized by Google

14329. You have a phrase here "were watering of the main roads to be universally compulsory many of the largest collieries in Yorkshire would be unworkable" ?—Yes.

14330. That is not the case with the collieries that you own or manage ?—I am perfectly certain that if we had to water the whole of our roads we could not work those collieries. I do not say that they could not be worked if you could get £1 a ton for all your coals, but I mean from a practical point of view they could not.

14331. At the price you are getting now ?—The price of the last few years averaging 6 or 7 shillings.

14332. Do you use much timber at the collieries ?—Yes.

14333. From what portions of the collieries do the small pieces of shale or anything else fall most often, parts that are well timbered or large pieces which are not timbered ?—We get a great deal from areas which are not timbered. The coal we are chiefly working is about 30 ins. thick, about the height of this table, and the main roads are 5 to 6 feet, and where we get the greatest trouble is 2 or 3 ft. blown down over the coal. That is perpetually scattering small pieces coming off both the sides and the roof.

14334. That is always the case ?—That is always the case, especially in the three hot months of the summer, July, August and September. We have more bother in those three months than all the other nine put together.

14335. Is it not possible to find out whether those pieces are ready to fall, or that there is no danger of falling, by examination ?—It is not possible with the length of roads that we have that a man should go round at night or morning and get off every small piece that is likely to fall on the next day.

14336. You are not carrying out the rule for examining the roads with that minuteness necessary to prevent these things falling upon the men ?—I do not think that it is possible that a man should go round at night and prevent every piece that can fall the next day.

14337. Take the morning examination before the colliers begin to work ?—Yes.

14338. Are not your main roads examined then ?—Yes.

14339. Is it not possible to see these pieces that are hanging or likely to come loose then ?—No, I do not think that it is.

14340. It is after the men begin to work that the danger arises ?—It is. Whatever pains you take you cannot prevent these small pieces coming out. As soon as the temperature of the air on the surface gets to a higher degree than the temperature of the colliery the moisture from the air condenses on the soft sides and pieces are perpetually coming off.

14341. At that period of the year ?—At that period of the year.

14342. You know, then, that is the case year after year ?—Yes.

14343. Is there any extra precaution being taken to examine these places then ?—Yes, we take all precautions we possibly can. We do not want the pit to stop if we can possibly help it.

14344. And still you have these pieces falling ?—Still we have this difficulty every year.

14345. What kind of roof have you ?—What we call bind—shale.

14346. Is that the actual roof after you have ripped ?—That is the actual roof for some distance above the coal.

14347. Shale ?—Yes.

14348. Do you keep long distances of that soft shale without being timbered ?—Yes.

14349. Do you consider that safe ?—Yes.

14350. (*Mr. Enoch Edwards.*) Have you had any experience of colliery disasters where you have been manager—explosions ?—Not large ones.

14351. So that you do not know from your experience what would be the exact conditions of the particular pit before an explosion ?—No, that is so. I have never been down a pit within a few days before an explosion.

14352. You have gone down afterwards ?—Yes.

14353. I understood you to say that you had visited collieries in North Staffordshire ?—Yes.

14354. What collieries were those ?—I have been down the Sneyd Collieries and one the name of which I have forgotten in the same neighbourhood.

14355. You would find there rather defective arching ?—I do not remember the arching particularly.

14356. Have you been down the newer collieries, the recent collieries ?—No.

14357. You know the enormous depth now ?—I know that they are a great depth now.

14358. They have them arched with the white bricks ?—I do not know that.

14359. I suppose you agree that if a length of roadway can be arched it would be possible to prevent the spread of an explosion ?—Yes, I am in favour of arching where it will stand.

14360. I know that you give your evidence here on behalf of the West Yorkshire Coal Owners' Association ?—Yes.

14361. Are they averse to this suggested watering of mines ?—Yes.

14362-3. Is it on the ground of cost ?—On the ground of cost and on the ground of safety as well.

14364. It is not unusual for colliery people to be averse to any change in the working of collieries ?—No, I do not think you can say so. My experience is that a colliery owner or manager is willing to adopt anything that he thinks will be of advantage, especially in the way of safety.

14365. I will put it in another way then. Would it be correct to say that in every change suggested by legislation they formed a very exaggerated view of the cost of it ?—No, I think not; I think that every change that has been brought about by legislation had already been adopted by a great many colliery owners before the legislation had taken place.

14366. Is it correct to say that they formed a very exaggerated view as to the cost of it ?—No, I do not think so.

14367. Did they do that with the Workmen's Compensation Act ?—I do not think that we have seen the entire result of the Compensation Act. It is increasing every year.

14368. You are old enough to remember the debates on the Act of 1872, the first great Mine Act. What was the view then taken of it by colliery people ?—The view was that it would increase cost, which it did.

14369-80. A rather exaggerated view ?—I do not know as to exaggeration: I am afraid I cannot charge my memory so far back as 35 years.

14381. You yourself, from your experience, are fully aware of the main purpose of this Commission ?—Yes.

14382. And that the special subject that we are considering here, about which you have been good enough to give your evidence before the Commission, is to minimise the loss of life in cases of explosions ?—Yes, quite so.

14383. Of course that would be a subject which would appeal as strongly to you and other people as to anybody else ?—As strongly to me as to anybody else.

14384. You have no experience of the effect of an explosion in any dry zones referred to ?—No, I was down the Oaks when it was wrecked by an explosion as far back as 1868, but at that time the question of dust had not the importance that it has now. There is no doubt in my mind that the Oaks was a dust explosion. It occurred not far from the shaft.

14385. Largely in the early days of explosions when they talked of the Oaks they said there would be a considerable amount of dust, but there was a reckless disregard to the mischief of gas in mines in those days ?—I do not think so, the great question of the Oaks was where any gas could have come from. I think from what we know now the Oaks was entirely a dust explosion, and nobody believed or thought of it.

14386. Following the very sad experience of the Courrières Mine, I suppose you agree that it is desirable, if we can, to discover some means of preventing a recurrence of that sort of thing in England ?—It is, decidedly; there is no doubt whatever about it.

14387. At any rate, the greater development of the mines now and the greater number of men in the pit make it doubly important that we should try to find some solution of it ?—Quite so.

14388. You suggest that there are in many of these mines in Yorkshire, in your judgment, some in which it

Digitized by Google

Mr. John Nevin.

21 Feb. 1907.

would not be possible to have complete watering?—I do say that.

14389. In these pits, where it is not possible to have complete watering, is it possible to have well-watered zones?—I think it is possible to have dust-free zones, I do not go so far as to say well-watered zones. I think I have said that in my evidence. I think that is the best possible remedy that I can suggest.

14390. Of course, if you remove the dust you have the less to feed an explosion upon?—Yes.

14391. We are all agreed that all there is left to do after is to take all the life away from it you can?—Yes.

14392. It will die by itself if not fed?—Yes.

14393. You say here in spraying the coal when it leaves the face it causes great danger in screening. What about a limited quantity of water being put on the top of the tub; that would not have much effect upon the screen?—It depends. If you can put exactly so much water on the tubs as would evaporate by the time the tub came to the downcast shaft you would do no harm at all, but the question is, if you water it sufficiently to leave the coal to be wet when it comes to the top you have a great difficulty in the screening.

14394. I am not suggesting for a moment that you should water it in that way, but I am suggesting to you that it might be so sprayed when it leaves the face that it would prevent or reduce very largely the possibility of dust escaping and not damage the screens?—It would have to be very carefully done, more carefully done I am afraid than you can find people to do it.

14395. I know you refer here to the liability to spontaneous combustion if the coal be stacked?—Yes.

14396. I suppose you mean stacked without screening it—without cleaning it?—It does not matter, if you put damp coal in a heap it will fire without fail.

14397. You do not want to suggest to us that coal screened and the dirt—which is the first to fire usually—and the small taken out of it will be as liable to spontaneous combustion as when it has been screened; it would not be so liable?—Taking our own case, you have more danger of fire if you screen the coal first, because you let more air into it; but as long as you put it with the small in it it lies more dead and the air does not get to it. If you screen that coal, and put it in a heap, you have more danger of fire than you have now.

14398. Is that your experience of it?—That is.

14399. I should be surprised if that was the general experience in stacking coal?—I do not suppose it is; but ours is tender gas coal. A very small amount of our coal will be in pieces the size of your head; it is very different from stacking round big steam coal.

14400. You are careful to note that the ship may take fire with it?—Yes.

14401. You were asked about shot-firing in the main haulage roads. I think we are pretty well agreed that if you can prevent an explosion at its source it will rid us largely of some of the other difficulties?—Yes.

14402. What is the object mainly of firing a shot in the main haulage roads?—In cases where your road for one reason or another has got too small, and you have reason to enlarge a road.

14403. The bottom is lifted, or the top come down, and the size is reduced?—Or you may want to make a pass-bye. I will put it in this way—that you want to enlarge your road.

14404. Make a junction from it?—Yes.

14405. Would it be in the solid roof, or bass or shale?—It may be in the roof, or it may be in the floor, or it may be in the sides. I simply put it in this way—that you want to enlarge your road.

14406. Is there much risk of an accumulation of gas in that way?—Not as a rule in an intake airway. We have had explosion after explosion in intake airways, where there could not have been gas—the Altofts explosion, and the Seaham explosion.

14407. If it was well watered in the neighbourhood of a shot there is no likelihood of an explosion?—There should not be.

14408. I understand that the man who fired these shots is the ordinary fireman in your collieries?—As a rule.

14409. What do you think of the suggestion that is made that the man who fires a shot on the haulage road should not be allowed to do so unless with the written consent of the manager of the colliery?—Yes, I think that is a reasonable thing to suggest, knowing what we do about these explosions.

14410. Of course, it would be necessary with that written consent that the manager should have seen the place?—I should think the manager or the under-manager. I have not gone so far as to say exactly what the rule should be.

14411. If the risk is so great, and I think everybody seems pretty well agreed that the risk is so great, from explosions in the main haulage roads, is it not important that the superior wisdom and judgment of the manager should be brought to bear always upon that particular point?—Yes, I agree to that.

14412. You would not suggest that the more important functions of a manager should be relegated to anybody?—It is difficult to say. Of course as you very well, and we all, know a manager must delegate a great deal of his duties to his other people. A manager cannot look at every shot in a large colliery, and I am not prepared to say that the manager himself should inspect every shot fired in the haulage road, but I think that there should be stricter rules than there are now.

14413. It is an uncommon thing to have shots in the haulage road?—As a rule it is.

14414. It is not asking a great deal of a manager that he should see this particular place, having regard to its importance, before he gives that certificate?—Yes. If you will include the men with either first class or second class certificates, manager or under manager, I agree with you.

14415. Take the manager responsible within the law. In that case you think that it would be a good thing if it is included?—I should be inclined to, that a certificate should be given by either the manager or the under-manager having a certificate.

14416. Give authority to fire shots in that particular place?—Yes.

14417. (*Chairman.*) I thought you suggested to me that it ought to be the manager. I suggested to you that it ought to be the manager to give a certificate?—The manager of a large mine may have some miles of road under him and he will not be able to inspect them every day and, therefore, I should not confine it to the one manager.

14418. Then the one manager, beyond taking the advice of his under manager on an occasion where he found it impossible himself to go down, might trust to the under manager. Would you make the manager himself responsible for giving a certificate of that kind?—I should make the manager or the under manager. I should make a man who has a certificate of competency either first or second class.

14419. You say manager or under manager?—Yes.

14420. I should like to ask you one question about the wooden props. Do I understand that your attention has been called to the question of whether wood would deteriorate or otherwise by being constantly damp?—No, I cannot say.

14421. That is not one of the dangers that you suggest by watering the mines, that the props would be rendered more liable to break than they are at present?—No, my attention has not been called to that in this matter of watering, but, of course, we all know that props that are exposed to damp rot far quicker than those that are kept dry.

14422. We do not all know that, because one of the witnesses told us the contrary. That is your view at all events?—Yes, that is my view.

14423. Props kept dry are always more liable to get rotten?—I say props that are kept damp. We know that some wood kept under water will keep for years. Old Roman piles are found occasionally 2,000 years old.

14424. You think where wood is constantly kept damp and not allowed to get dry meantime, that that process of keeping damp deteriorates the wood?—I believe the most difficult place to put wood is where it is alternately wet and dry, that goes most quickly I believe.

14425. As regards wood kept damp constantly, you do not know whether it would affect it?—We know wood in the returns, where it is exposed to damp air, rots very quickly.

14426. (*Mr. Smillie.*) Mr. Edwards put some questions to you with regard to whether or not certain exaggerated statements were made by the colliery owners and their

Digitized by Google

representatives in the event of new legislation for safety or otherwise ?—Yes.

14427. I think you said you did not think that that was so, from your experience ?—No, I do not think that is so. It is very difficult when a new Act comes in for a man to say what the result will be. He can only estimate to the best of his knowledge.

14428. Have you ever known any reforms suggested by miners in the interests of life and limb which have not been bitterly opposed by the mine-owners on the question of cost ?—I do not agree with that at all. As I said, I think, to Mr. Edwards already, I do not think that any legislation has taken place that has not already been brought into use by a great many mine-owners.

14429. I am sure that you have read the debates which took place in the Commons and in the Lords when the first Mining Bill legislation was introduced. Was not it pointed out on behalf of the colliery owners that it would shut down mines if that Act was passed, which proposed to put women and children out of the mines ?—I was a colliery manager before 1872, and we had no women and children in the mines then.

14430. Have you read anything about the early history of mining legislation ? I am sure you have. You might just tell us. Have you read Lord Londonderry's statement in the House of Lords with regard to putting women and children out of the mines ?—No, I do not think I have, but I know that years before I had anything to do with collieries there were no women and children in the mines, in 1870 or 1869.

14431. Mr. Edwards suggested that you were here on behalf of the mine-owners, really opposing any step which is going to deal with rendering dry and dusty mines more safe than they are at the present time.

14432. (*Mr. Ratcliffe Ellis.*) I do not think that is in Mr. Nevin's statement.

(*Witness.*) What I am here to oppose is this: that we do not want an Act passed which will cause greater loss of life in the mines from other causes. We know that the deaths from falls of roof and sides are so very much more than the deaths from explosions, and we do not want to run a greater risk for the sake of saving a smaller one. Nobody in this world can be more anxious for life-safety than colliery owners are.

14433. (*Mr. Smillie.*) The miners think differently, of course. Two or three colliery disasters in this country would bring up the death roll pretty close to the total amount of people killed by all other forms of labour ?—I am not here to oppose legislation at all.

14434. Do you understand what is meant by spraying full trams on the way to the pit bottom ?—As I understand the idea, it is to spray the trams before they go on to the haulage road.

14435. Or on their way at some point to the pit bottom at the beginning of the haulage road ?—Yes.

14436. It is not meant to drench the tram, but simply spray the top to prevent the dust coming off the top ?—If you can spray just sufficient to prevent the dust coming off the top, and the coal should be dry when it gets to the shaft, there is not the slightest objection.

14437. Do you stack very much coal in Yorkshire ?—Yes.

14438. Do you stack it in the open ?—In the open, generally.

14439. Do you wait for dry weather before stacking, or do you sometimes stack in wet weather ?—As a rule the coal with us is stacked in summer when the weather is generally dry. If we have wet coal coming out of the pit we are very careful not to stack it with dry coal.

14440. You might stack it on a day when there is more rain falling than you would get with what we call spraying ?—It is not possible; it does not often happen.

14441. It does happen ?—Very rarely.

14442. Would you stop stacking the coal if it is thought that a very wet day causes danger of spontaneous combustion in your stack ?—That would depend.

14443. I suggest that your answers to those questions have not been clear or so fair as they might have been. Your coals go in wagons a considerable distance to the port of export coal ?—Yes.

14444. Do you usually select dry days to send your coals there ?—We have to send the coals whatever the weather is.

14445. You might have such a day of rain that your wagon going to the ship's side would more considerably wet the coal than any spraying that took place underground ?—That depends upon the amount that took place underground.

14446. Spraying the tops of the trams would prevent the dust coming off the top and landing on the roadway ?—I have given my opinion about that. If you can lay the dust and the coal will not be wet when it gets to the surface that will be a good thing. If you are going to spray them so that the coal will be wet when it comes up and goes into the heaps I am against it.

14447. One of your reasons being that when it is conveyed to the ships that there is a danger of spontaneous combustion, is it not ?—Yes.

14448. If the wagons on the railway do 20 or 30 or 40 miles, as they may have to do in some cases from the colliery to the port, on a very wet day, would not they get far more water than they would in spraying ?—It depends how much water you put on in spraying. We have known cases of spontaneous combustion from the wet coal being put in. If all the coal has to go in wet we shall increase the danger of it, that is my suggestion.

14449. I suggest that your theory with regard to spraying the tubs does not carry any real weight with it because the same thing takes place when you are stacking the coal and when your wagons of coal go to the port where they are put into the ship, when sometimes the rain is running through the bottom of your coal wagons ?—I have not seen that. All I have got to say is that it is already a danger and we do not want to increase the danger.

14450. You say in new collieries that screens might be placed away from the downcast shaft so that the dust might be collected by fans. I expect that there would be considerable cost when they are erecting machinery for collecting it by fans. It has been done at Cadeby ?—Yes, one or two places I know.

14451. That might mean closing up really of the screenings where the picking tables and belts were ?—Yes.

14452. Mr. Ellis suggested that the raising of the downcast shaft by some method out of the zone where the dust is might be another method ?—Yes.

14453. Where there was difficulty at old collieries which might go many years yet in removing the screens, I suggest that there might be a dumb drift driven at a very small cost from the mouth of the downcast shaft 40 or 50 yards away, and that that might act as your downcast without carrying the dust down. Do you think that would be practicable ?—In some cases it might. It just depends upon the situation of your colliery. In our own we could not do it, we have so many buildings all round.

14454. It would not injure the ventilation ?—No, I quite agree anything that prevents the dust coming down is advisable.

14455. Where it can be done without a considerable cost, where it is possible without running the risk of stopping the collieries you would have wet zones, would you ?—I should say dust-free zones; I should prefer to put it dust-free zones.

14456. Either arched or cemented along the sides so as to be able to keep it dust-free ?—Yes.

14457. For certain distances ?—Yes; the distances one cannot say without experiment.

14458. You think that if it is reasonably proved that either dust-free or wet zones are required to prevent the spread of an explosion, that should be done generally where there is danger ?—I think so.

14459. You agree that is so ?—I am sure as representing the West Yorkshire Colliery Owners anything that can be reasonably done in any shape to prevent an accident like Courrières, they will be only too glad to do.

Digitized by Google

TWENTY-SECOND DAY.

Wednesday, 6th March, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
H. H. S. CUNYNGHAME, Esq., C.B.
ENOCH EDWARDS, Esq., M.P.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.

S. W. HARRIS, Esq. (*Secretary*).

Mr. WILLIAM CUTHBERT BLACKETT called and examined.

Mr. W. C. Blackett.
6 Mar. 1907.

The Witness handed in the following Statement:—

14459A. Mining and Mechanical Engineer; Agent to the Charlaw and Sacriston Collieries Co., Ltd., Durham; Consulting Viewer to the Houghton Main Colliery Co., Barnsley; Member of the North of England Institute of Mining and Mechanical Engineers, and of the Institution of Mining Engineers, of which he has also been Vice-President and on the Council; has given much thought to the subject of coal dust, and had considerable experience in recovery work and as an explorer after explosions.

(1) Before considering the subject of dust in coal mines, it seems absolutely necessary that some reliable conception of what takes place in a mine explosion should be formed.

(2) Thirteen years ago witness read before the North of England Institute of Mining and Mechanical Engineers a paper on the "Combustion of Oxygen and Coal Dust in Mines," wherein he endeavoured to draw a mind picture of what occurred, and as this was expressly intended for the perusal of ordinary mining officials like himself, it was couched, as far as possible, in popular language.

(3) Witness, on re-perusal, after long experience, finds no reason to very materially alter his then-expressed views.

(4) Briefly, the theory formed was that there is, first, an initiatory force to raise a sufficient cloud of dust, accompanied by a great volume of incandescent heat.

(5) The consequent expansive force produces an onrush of air, stirring up dust, followed by flame, and developing ever-increasing velocities and pressures.

(6) At the forefront of this the current is, of course, more gentle, and only follows those paths which are open-ended and free. A door or a stopping may prevent entry, and when explosive violence arrives these are blown down, but if no prepared conditions are beyond, the path for combustion will fail.

(7) If in one direction a powerful ventilating current is met and reversed, it can be conceived how much intercompression there would be, which would produce a more concentrated mixture of air and dust. This accounts for the fact that the violence is usually greater out towards the fresh air of the shaft.

(8) In any case the superior velocity produced by the explosion in overcoming the inertia or momentum of the usual current going or coming in must produce great compression.

(9) Witness first suggested this action over 16 years ago, and then described what he called these "pioneering phenomena."

(10) If these "pioneering phenomena" can be prevented, dust explosions cannot take place.

(11) Therefore anything which prevents the current of air prevents an explosion. Hence it cannot advance into galleries at the face, which are like a *cul-de-sac*. This was noticeable at Urpeth.

(12) Anything which sufficiently enfeebles the velocity of the current prevents an explosion. Hence opening out into a large space or into a spread of other galleries would produce the same result.

(13) Anything which, while allowing the air current does not permit of its preparatory admixture with dust, would prevent an explosion. Hence the removal of the dust, or the turning it into a dried cake, or the making of it moist, is effectual. It is possible that in pits where ankylostomiasis is present and water feared, experiments with oil or tar might be useful.

(14) Because the "pioneering phenomena" cannot become effectual into the face of the workings, men who are there at the time of an explosion, in galleries wherein the air becomes stagnant owing to the destruction of stoppings, crossings, &c., are often safe and would be well advised to remain.

(15) Dust at the face is not usually dangerous, like that on haulage ways.

(16) It is finer and more plentiful on haulage ways, because it is selected and deposited by the air current.

(17) It should not be forgotten, however, that certain dusts seem to have the power of themselves absorbing oxygen or air and in time becoming more inflammable, and therefore this may also be a reason for the greater danger of haulage road dusts.

(18) The principal source of dust is (*a*) down the shaft from the screens, and (*b*) that shaken and blown from tubs.

(19) The two principal sources to produce the initiatory force and ignition spoken of in (4) are the firing of a mixture of firedamp and air and the firing of shots in dusty places. Witness thinks it is within the bounds of possibility to have an inflammation of dust in a mine by a naked light, but this is so very remote as to be negligable. If a fall could take place so heavy as to produce a cloud of dust as thick as that in the Brancepeth hopper, and there was a naked light, this might occur. Such a fall and combination of conditions is nearly impossible.

(20) Both these first-named sources should be impossible if existing rules were intelligently carried out.

(21) The human element is the great danger. Recent explosions which have come under the observation of witness have been distinguished either by flagrant disregard of rules or by display of ignorance.

(22) Disobedience of rules can never be prevented. Ignorance, however, might be, to some extent, removed. Some elementary teaching in mining districts might even be done in schools.

(23) There are very many mines which could be classified as non-dusty. Witness himself has more than one example.

(24) Mines which would not come in this category vary much in their characteristics and have many grades

Digitized by Google

of dryness, and some being only in parts dry. Of these there are again three classes:—

(*a*) Those which will permit a great deal of watering.

(*b*) Those which will permit of slight superficial (but still very effective) watering.

(*c*) Those which cannot be watered at all except under specially prepared conditions.

(25) Some of the mines with which witness is connected in Durham belong to the first class. Pipes are carried into several of the main ways and hose-pipe and nozzles used about every fifty yards, so that the top and sides are washed down. Where there are no pipes, a water tub is used. Korting's spraying nozzles are found to be excellent. Continuous watering is not found necessary. The dust is washed down and forms a cake, watering being discontinued until signs of dust re-forming are seen. Continuously the *debris* is being also filled away and removed. No shots are allowed to be fired on any main haulage way without special permission. Only ammonite is used with electric batteries.

(26) A colliery with which witness is connected in Yorkshire, working the Barnsley Bed at 269 fathoms depth, belongs to the second category. Originally no watering whatever was done, and the dust was excessive, although 15 or 18 tubs a day were filled and removed. A quantity of dust went down the shaft from the screens. Recently the following precautions have been taken. All shot-firing has been stopped; and before any were allowed for exceptional purposes, special consideration would be given. It is fortunate that this has been possible. Two Korting sprays are fixed at the top of the downcast shaft, water being put through them at a pressure of 60 lbs. per square inch. These thoroughly dampen the coal dust carried from the screens. In frosty weather, when it is not advisable to have water running in the shaft, owing to its effect on the tubbing, two steam jets are used, but these are not so effective as the water sprays. The dust is deposited in the sump instead of being carried into the haulage roads by the air current. Sprays are being placed at intervals in the haulage roads and each forms a wet zone. It is not found necessary to work them more than four or five times a day, owing to the quantity of water which passes through them. No trouble has been experienced as yet from the roof or floor. In addition to the water sprays underground, several water tubs are continually running to and fro, which effectually lay any dust formed during the day. The tub is a simple one, with perforated pipes underneath.

At night time, men clean the roads, and the *debris* they thus get is filled up, but does not now amount to more than about one tub per night. The difference in the aspect of the waggon-ways is extraordinary.

(27) Witness is not acquainted with mines of the third class. He has, of course, seen parts of mine galleries where it would be impossible to use any water safely, but is not acquainted with any mine where that is a universal characteristic, and, therefore, must leave evidence on this point to others. Shales and fireclays are the stones which would be mostly affected, and great depths would add to the difficulty. It used to be not uncommon practice, where blasting could not be done, for stonemen to water such stone before leaving it at night, in order to find it softened for their hand tools the next day. In such a mine as this of the third class, it would often be possible to select a favourable site and provide a constructed zone in each branch haulage way which could be kept damp by a spray.

(28) In order to prevent dust going from the screens, witness is using shields round the pit top, and is preparing to box in the screens and exhaust air therefrom, along with the dust, by means of steam-induced draught nozzles, subsequently recovering the dust.

(29) In considering the question of more rules, witness would like to emphasise that he has never yet found any explosion within his experience which would not have been prevented had rules now existing been intelligently carried out by the workmen.

(30) He would earnestly represent that the existing rules should be made fewer and more simple.

(31) The ordinary workmen do not often read them, and cannot fail to be confused. So also are others. Witness gravely doubts the wisdom of training men to be taken care of rather than teaching them to take care of themselves.

(32) If it is thought, however, that additional rules to deal with dust are necessary, witness suggests that at this stage all that is necessary would be—

(*a*) No shot to be fired on any main haulage way without the written consent of the manager or under manager.

(*b*) In every main haulage road of each ventilating district there shall be a length of, at least, 50 yards, which shall be maintained in such a condition as to be free from dust on top, sides and bottom.

(33) Witness further ventures to suggest the undesirability at inquests, after colliery accidents, of the employment of gentlemen unacquainted with the technicalities of mines as official reporters to the Home Office.

There is a great waste of time at the inquiry, and the resulting report is sometimes misleading, as was the case at Brancepeth, the consequence being a document which for future reference is unreliable. The inspectors are the best men to make such reports.

14460. (*Chairman.*) With regard to recovery work, and as an explorer after explosions, will you tell the Commission something about your experience?—I saw a good deal of Seaham, Tudhoe, and Trimdon Grange explosions, and a little of Usworth explosion; but of course they took place a long time ago and my memory is not quite certain as to them.

14461. How lately have you explored?—Then I came on to Brancepeth, Wingate, and Urpeth. Urpeth is the last one.

14462. Did you explore very shortly after these explosions had taken place?—Yes, in most cases immediately after, and in the latter ones particularly so.

14463. In what part of the country were those explosions?—All in Durham.

14464. Then outside Durham you have had no experience of explosions?—Not outside Durham; except what I have read of.

14465. You refer to a paper which you read on "Combustion of Oxygen and Coal Dust in Mines," and you say that the statements in that paper you still adhere to?—Yes, in the bulk. There may be little changes which time has produced, but practically I hold the same views as I held then.

14466. Was that a long paper?—No, not very long.

14467. I was thinking whether you would like to have it printed in the Appendix?—Well, I give the gist of it in this statement.

14468. You think that what you say to-day will be quite sufficient?—Yes, I think it practically covers all the points.

14469. You say that a door or a stopping may prevent the entry of the current of an explosion, and when explosive violence arrives those are blown down, but if no prepared conditions are beyond, the path for combustion will fail. What do you mean by "prepared conditions"?—The principal point of the paper was that an explosion must follow the path of air, that it is pushed in front of it, on a dusty place; it is like the point of a wedge—the rest of the wedge must follow the point, and whatever way the front of the air or the point of the wedge finds easiest to go the other follows, and as it becomes more violent it stirs up the dust.

14470. But supposing this current goes along till it meets two roadways or adits, or some pathway of some kind—two pathways at an acute angle—so that some of it will go down one and some down the other, then do you think that the presence of dust in any one of those pathways and not in others will have any effect in directing the course of the current? I suppose the course of the current would be simply determined by the road which it was taking when it got to where the roads diverged, and there being dust or no dust would have no effect; I mean the explosion would not have a tendency rather to follow that roadway which was strewn with dust than the other roadway?—Oh, yes.

14471. You think it would?—Part of the preparation for the path of the explosion is the disturbance of the dust.

14472. Then supposing that an explosion reached a point at which the roads diverged, and one of those roads was dusty and the other was clean, the explosion would naturally go along the dusty one, and even a very small amount of current would be sufficient to make the explo-

Digitized by Google

Mr. W. C. Blackett.

6 Mar. 1907.

sion go down the dusty road ?—It could only go down the dusty one. If there was no dust on the other it could not follow.

14473. But I thought you said the path of the explosion would be entirely governed by the current going the easiest way that it could possibly find ?—Quite so. Supposing the two roads which you have assumed are equally dusty and equally dry in every respect, but one had a door in it, and that particular door would resist the gentle first current, but the other one being open would not resist it, then the other one which was open would practically allow the preparation of the path, and that one would be the one that the explosion would follow, and in all probability, although that door would be blown down when the explosive violence came, yet beyond, the path not having been prepared, the explosion would not follow. It would not be an invariable thing, because it is quite possible that the door might be blown down and a path prepared, so to speak, in a hurry ; but, still, from what I have observed, it would not be the case.

14474. If the explosion were strong enough to blow the door open, surely if there was any dust beyond it would be strong enough to stir up the dust and carry on the explosion ?—If it had time. It does not seem to me that in nine cases out of ten, or perhaps a greater proportion than that, that would occur.

14475. So that even if an explosion were so strong that it blew out a door, you say that unless the pathway beyond that door was unusually dry and dusty—very dry and dusty indeed—you think the explosion would probably be stopped ?—I think it would be stopped.

14476. And that it would require a very dry and dusty road on the other side of the door to carry it on ?—I think the probability is it would be stopped in any case and only follow the other way. You see the dust beyond the door could not be raised ready for the fire when it came ; you must have it raised thick, and the only thing that can raise it in that manner is the current of air that precedes the explosion. If you have prevented that current of air then the path is not ready for it.

14477. I should have thought that if a current of air was strong enough to blow a door open it would be strong enough to raise the dust ; and, that dust being raised, the flame would proceed on its way ?—It might do so, but I say the probability is that it would not, in many cases.

14478. That is your view. So that you consider that although a doorway might not be strong enough to prevent an explosion blowing it down, still, at the same time, to have a doorway in your roadway would be sufficient to stop the explosion ?—In that case, with a choice of paths, I think it would.

14479. But if there was no choice of paths, then what would happen ?—Then I think the same thing might happen. It does happen in going in over where there is not a door but where there is a solid gallery end. An explosion cannot follow where there is no air movement gone before it. Dr. Haldane appears to be looking at some of the Seaham plans : at Seaham there was an instance given by Mr. Atkinson where there were two paths left each other at an angle and came together again at the other end. The pioneering current divided at *this* point ; *this* was the free path to go, and *this* was the one that met the other (*describing*). Now the current to some extent divided *here* and entered this right-hand path, but before it got very far along the one that had gone left-hand had pushed a current into the other end, and the two currents met like that (*describing*), produced a stagnation in between, and the explosive force did not follow up that right-hand path.

14480. But it does not seem to me to follow in the least from that, that where you have an explosive force so great that it blows down a door, the zone or the roadway at the other side of the door would be immune from danger. It seems to me that that was merely a case of current meeting current, and the air being stagnant—the current being in fact finished off altogether at that point ?—The current was unable to get violent enough in between and the dust was not raised. But a door would have prevented the same thing.

14481. (*Dr. Haldane.*) I should like to ask you whether the condition of that travelling road which escaped or mostly escaped was that it was free from dust ?—No, it was not free from dust.

14482. I mean the explosion did not stop because it was free from dust ?—Oh, no—not in my opinion.

14483. I see on the plan the place you are referring to ?—Yes, that is the place (*indicating on Plan*).

14484. You are convinced that it was not because of freedom from dust ?—Yes, I am quite convinced of that.

14485. (*Chairman.*) What is the practical conclusion that we may draw from your theory ; that it would be advisable to have partitions underground every now and then in order to prevent an explosion following ?—No, it does not follow. I merely begin my argument in that way ; anything by which you can reduce the speed of the preceding current of air would tend to reduce the violence of the explosion afterwards, if not prevent it.

14486. (*Mr. Ratcliffe Ellis.*) The dust to be dangerous must be in suspension, I suppose ?—It must be raised into suspension.

14487. So that if there was not enough wind to take the dust off the bars, but it was left there, it would not do much mischief ?—That is so.

14488. (*Chairman.*) But what I do not understand is this : if a current of air is strong enough to blow down a door, surely it is strong enough to raise the dust as it goes along ?—Well, if that had been the door (*pointing to door*) and the current of air had been blowing up the passage outside raising dust outside, it could not have raised dust in this room. But then comes the flame, and the expansive violence for the moment blows out the door, but when it just gets through the door the dust is not raised in this room ; therefore, it cannot explode it, and it has gone past before the dust is raised.

14489. You mean the flame travels quicker than the dust is raised ?—Yes, I have taken it to be so.

14490. That is your theory ; the dust is raised by and bye, but it is not raised in time to be ignited ?—That is so. I have no doubt that by and bye there is a large amount of dust raised, but by then I think the flame has either gone by or been cooled down.

14491. Then you speak about the explosion at Urpeth as showing that your theory is correct ?—Yes. In that case it was not doors, or it was not absence of dust, but it was merely that it was a wet space through which the path could not be prepared. It was very conclusive at Urpeth.

14492. How far was the wet space ?—There were three galleries.

14493. Well, that is a different question, as to wet space, I should have thought, because we are now dealing with the case where a road is dry and dusty, and you say that even where a road is dry and dusty and the explosion may force open a door, and may force a current of wind into the dry and dusty roadway ; still, at the same time, the flame will proceed before the current has had time to knock up the dust, and consequently there will be no explosion. But now we have got into a different question altogether, namely, how far wet zones will stop an explosion ?—To my mind, it does not present itself as a different question. It is merely this, that instead of that door we have a long passage here to the room with no dust in it ; but we have all the passage wet, and the current of air has come in and has disturbed the dust inside, but, there being no dust in this passage, the flame cannot pass over the two.

14494. But you told me that, although a road may be dry and dusty, if the current of air has been stopped by an obstacle, the flame will go on, and the current of air being stopped by the obstacle will hang behind the flame, and the consequence is that the flame will go through before the dust is raised ?—Yes, but both for the same reasons ; it did not come through this room because there was no dust raised in it ; the dust was lying there, but it was not raised in it ; and it cannot come through the wet space because the dust is lying and not raised. It is the same reason, to my mind. Similarly, I think I observe that if the passage opened out into a large enough space, so that the air current got gentle and not sufficient to raise the dust, then the explosion in all probability would die out.

14495. You say that the removal of dust, or turning it into a dry cake, or making it moist, would prevent an explosion ? Then you suggest that it is possible that in pits where ankylostomiasis is present and water is feared, experiments with oil or tar might be useful. What would you do with oil or tar ?—I am not quite sure at the moment what I would do with oil at all down a pit, but I should like to try what the effect would be of oiling the whole gallery, and leaving it in that oily state, so that it could not be dusty. Obviously, the use of oil could not encourage ankylostomiasis, and yet the place would be moist with oil.

14496. How much oil would you use ? Would it be a very expensive matter ?—That I could not say until it

Digitized by Google

has been tried by experiment. Of course oil has been used upon roads to stop dust, and I do not see why it should not stop dust on roads down a pit.

14497. You mean by the use of westrumite and things of that sort ?—Yes, something of that kind.

14498. Then you go on to say what we have heard from several witnesses, that in the case of an explosion probably the safest thing for the men to do would be to remain in the working place instead of going out ?—Yes, I am quite sure of that. I have seen that so often ; it was particularly noticeable at Wingate.

14499. I suppose you would suggest that the men should be told that that is the best thing to do ?—My whole sympathies are with educating the men and the boys.

14500. Then I think you agree with everyone else that the dust is finer and more plentiful on haulage ways. You say in Paragraph 17 of your Statement that certain dusts seem to have the power in themselves of absorbing oxygen or air and in time becoming very inflammable ? —Yes.

14501. You say this may also be a reason for the greater danger of haulage road dusts. Why should there be greater danger in haulage road dusts from that cause ?—Because the dust collects thicker on the haulage roads and seems to collect in some form, according to Dr. Bedson's experiments, and when they analyse it they find in the dust oxygen from the air, apparently somewhat similar to the phenomenon that takes place in charcoal when it takes up the gases of putrid meat.

14502. So that you consider that the longer dust is allowed to remain in the haulage roads the more inflammable and explosive it becomes, and that it probably absorbs oxygen from day to day as it rests there ?—I will not say the longer it stays ; probably, so far as my limited knowledge goes, it might reach a saturation point and get no worse.

14503. Therefore you suggest that is a matter which should be inquired into—the possible absorption of oxygen by coal dust ?—It has been inquired into and ascertained by Dr. Bedson, I know ; but there would be no harm in further inquiring into it.

14504. This matter of oxgyen absorption by coal you think has probably been sufficiently inquired into ?—Well, I am not sure of that.

14505. You go on to say that the principal source of dust is from the screens and from the tubs, and you mention afterwards certain precautions to be taken with regard to screens. However, taking your evidence in the order in which it stands, you go on to say in Paragraph 21 that the human element is the great danger, and you express an opinion that recent explosions which have come under your observation have been distinguished either by flagrant disregard of rules or by the display of ignorance ?—Yes. I am most wishful to emphasize that—that if our present rules were only carried out intelligently by everybody, in my opinion none of these accidents, or none that I know of, at any rate, would have occurred.

14506. Sometimes this disregard of rules is wilful and sometimes it is through pure ignorance—because the men do not know ?—At Wingate it was difficult to say what it was ; we did not know quite, in charity to the man who was killed, what to say. But there it was most flagrant. At Urpeth the men had deliberately broken the rules.

14507. With regard to Wingate, you are not so sure ? —At Wingate I am perfectly sure the man had broken rules, but I am not quite sure as to his motive.

14508. You mean as to whether it might not have been through ignorance ?—Or zeal. I do not know which it was ; it might have been either.

14509. What do you mean by "zeal" in that case ?— I think probably the man might have been anxious to get on with work, and he could only think of doing what he did as being useful for the time ; but it was the most regrettable ignorance, and negligence as well.

14510. You say ignorance is a great cause. I suppose in regard to doing away with ignorance as to what the rules are, it would be a great thing to make the rules as simple and as short as possible ?—Yes.

14511. To have few rules and to make them as simple as you can make them ?—I think we have far too many rules ; we cannot think of them all. I defy anyone, from the highest to the lowest, to remember the rules. If it is a question of breakage of rules we have to go and hunt through them, and a former rule involves a later one, and we get confused—and if we get confused, how much worse will it be for the men.

14512. But certain particular men have certain duties to do. For instance, the fireman, the manager and the under manager, and all the officials of the mine have certain duties to perform. I suppose you say that the officials of the mine are generally well instructed in regard to the rules, and they know what they ought to do and what they ought not to do, and it is probably only the working collier that there is a difficulty with regard to ?—No, I am not going to make out the working collier any worse than the others. It is a matter of degree. The officials are better instructed, but I do not know that their memories are any better.

14513. You say that the rules now are so intricate and so numerous that even the officials of the mine find a great difficulty in carrying them into effect and not missing them ?—They find a difficulty in remembering them and applying them. They may remember the immediate everyday rules, but when the emergency arises they have to pause, and they are not quite sure. The latest Order confuses itself with the first Order, and so they have to go and look to their papers.

14514. But surely it takes a long time for Special Rules to be set up, and they are not being constantly altered, are they ?—Not the Special Rules.

14515. But do you mean that there are collieries in which the owners and managers have rules of their own which they expect the men to conform to ?—No, I am speaking more of Acts of Parliament and other powers—higher powers altogether.

14516. Do you mean the Explosives Orders and matters of that sort ?—Legislation generally.

14517. I suppose, for instance, you would say that there is a good deal of difficulty now in understanding exactly what you ought to do under the Explosives Orders when you are firing a shot ?—If you can study it out long enough, I think you can understand it at the finish, but it is difficult to remember everything. For instance, at Urpeth I found —it was not a very important matter—that the workman had stemmed both his shot-holes with coal dust ; the responsible deputy and the man both shared that between them. Then I remember at the inquest we wanted to recall whether the rule said that they had not to employ coal dust, or whether the rule said that they had to employ non-inflammable substances ; and I believe everyone there failed to recollect exactly what it was. One hunted up one rule and another hunted up an older rule, and I think at last we discovered, as we ought to have remembered from the first but did not, that it was a non-inflammable substance which had to be used. I do not mean to say that it was very important, but it illustrates the difficulties which there are.

14518. I see that as long ago as 1896, more than 10 years ago, the Coal Mines Regulation Act of that year enacted (as has been pointed out to me by Mr. Ratcliffe Ellis) in Clause 5, Sub-section 3, "In Rule 12 of the General Rules contained in Section 49 of the principal Act, for the words 'nor shall coal or coal dust be used for tamping' shall be substituted the words 'and only clay or other non-inflammable substances shall be used for stemming, and shall be provided by the owner of the mine.'" I should have thought that was a very important alteration which ought to have been present to the memory of the mine officials ?—It was in the memory of the mine officials.

14519. The 1887 Act says "nor shall coal dust be used." —They had it in their minds, all of it ; but the trouble was exactly which was the Rule that had been infringed—that was the point.

14520. I should certainly have supposed that an important matter of that sort would have been in the minds of the mine officials ?—So it was in their minds ; the difficulty was to find out what the Rule was which had been broken. They knew a Rule had been broken ; there was no doubt about that in everybody's mind ; the difficulty was to find it ; there were two Rules, one of which was older than the other.

14521. I confess I do not see quite how anything could be put much more plainly than it is in those two Acts of Parliament ; but I admit that all legislation by reference is unfortunate, and that it would be far better if we could do away with legislation by reference to a much greater extent than is the case now, so that it should be only necessary to look at the last Act of Parliament to find out what the law is on the subject.—Yes, but I do not think you have quite my meaning ; it was not that the Rule is not perfectly plain for everybody to understand, it was the confusion of memory owing to there having been two Rules.

Digitized by Google

Mr. W. C. Blackett.

6 Mar. 1907.

14522. (*Mr. Ratcliffe Ellis.*) That is to say, you did not know under which Rule to prosecute ?—Well, we could not recollect for the moment.

14523. (*Dr. Haldane.*) There was no doubt as to the substance of the Rule ?—There was no doubt as to the substance of the Rule, but we could not recollect quite how it all arose until we hunted it up.

14524. (*Chairman.*) I will go on to what you say about watering. You say there are three classes of mines ; those which will permit of a great deal of watering ; those which will permit of slight superficial, but still very effective, watering ; and those which cannot be watered at all except under specially prepared conditions. With regard to those which will permit of slight superficial, but still very effective watering, you are clearly of opinion that any slight watering can, under certain circumstances, be extremely effective, but it is not necessary to water a place so that it shall be sloppy and wet all through, in order to prevent an explosion ?—I do not think it is necessary to make it sloppy and wet all through; if it is damp it is sufficient.

14525. We have had it stated in evidence that quite accidental watering, just the slopping from pails, or something of that sort, is efficacious to stop an explosion ?—Yes, and more than that, if you once watered a place and got that place padded down and caked, it would in many cases prevent an explosion. It would not be necessary in all the cases to keep it wet. I can bring this best to your minds in this way : we all know what cinder paths are and cinder tennis-courts, and so on ; you have used a dusty material and you have wetted it and padded it down and got it into a solid hard mass ; it is dry and it will last in that dry state for a long time, and you cannot get dust off it. That illustrates what I mean. If you can produce that condition of things down a pit as you do produce it, and as I see it every day, it is not sufficiently dusty then for the dust to be raised.

14526. So that if you use a very small amount of watering and then pat it down into a hard cake, that will last a very long time without any further watering even after it is dry ?—It will last a considerable time after it is quite dry.

14527. But supposing explosions occur when it is quite dry, do you think the dust would not be raised ?—I think the dust could not be raised—in the same way as I have explained before.

14528. You say that in Durham some of the mines belong to the first class, that is to say, that they can be watered and that there is no difficulty in watering them thoroughly ?—Yes.

14529. You go on to show how the watering is applied, and you say " Continuous watering is not found necessary : the dust is washed down and forms a cake, watering being discontinued until signs of dust re-forming are seen : continuously the debris is being also filled away and removed." That has been done in those mines where it can be reasonably done without injuring the roadways ?—Yes.

14530. How many days would there be between the waterings ?—It would depend upon the mine and upon the weather—the state of the atmosphere.

14531. Might you go for several days without watering the mine ?—Yes, in many cases I think you could go several days.

14532. A week ?—You might go a week : you might go more in some cases.

14533. You say with regard to the second class of mines, with the Barnsley bed at 269 fathoms deep, originally no watering whatever was done and the dust was most excessive although 15 or 18 tubs a day were filled and removed. Then you say that a quantity of dust went down the shaft, and you mention the precautions which are being taken, and that shot-firing has been stopped. You use sprays which thoroughly dampen the coal dust from the screens, and in frosty weather two steam jets are used, but they are not so effective as the water sprays ? —No.

14534. I suppose there is very much less moisture with the steam sprays than there is with the water ?—Yes—that must be the reason.

14535. Of course it is a very great improvement that all this is done ?—It is most marvellous to me ; it is far more improved than I should have imagined possible.

14536. That is with 15 or 18 tubs of dust a day. You say " Sprays are being placed at intervals in the haulage roads and each forms a wet zone. It is not found necessary to work them more than four or five times a day owing to the quantity of water which passes through them. No trouble has been experienced as yet from the roof or floor." Has that been very expensive ?—No, not very.

14537. Then it is efficacious, and not expensive ?—In this case it is most efficacious ; but we have only as yet had two sprays in the shaft and, I think, two underground. But that very small provision has made a most marvellous change. We use these sprays. (*The Witness produced a spray.*) They are far better than a large amount of heavy watering. I do not know whether you have seen them.

14538. I do not know whether I have seen that particular make of spray ?—They make a very fine cloud which makes a rainbow at sufficient pressure in the sun.

14539. And it does not take a very great deal of water, I suppose ?—No, it does not take very much water.

14540. Do you think that the amount of spraying which you have used in this particular mine is sufficient, or would you rather see more done ?—I think it is sufficient so far as we have carried it out, and we are going to carry it a little further.

14541. How much watering do you require ?—I have not measured the water, but it is more or less what you might call superficial watering ; it is not sufficient to get into the stone in this case.

14542. It is not sufficient to get into the stone so as to do harm. If it got into the stone it would disintegrate it ? —In this case it is not sufficient to hurt the stone. We rather feared it would.

14543. It has effected a marvellous change, and the cost is insignificant, I think you say ?—It has indeed. I can go into the mine and come out cleaner now. The cost is not great.

14544. At all events, the benefit to the mine far outweighs any cost that is incurred ?—Yes, so far as that is concerned.

14545. Then as to the third class ; you say you are not acquainted with mines of the third class which cannot be watered at all ?—Not as to whole mines. I know parts of mines in which that would be so.

14546. You do not know any mines where no part of the mine could be watered ?—I do not myself. I have heard of them.

14547. You say that in a mine of the third class it would often be possible to select a favourable site and provide a constructed zone in each branch haulage way, which could be kept damp by a spray. That you would suggest should be done wherever it can be done ?—Yes, I think it might.

14548. Then you say it is very important to keep the dust from the screens from going down the pits, and you say that the best way to do that is to use shields round the pit top ?—Yes. That is what I am doing myself.

14549. You box in the screens and exhaust the air from them along with the dust by means of steam induced draught nozzles and then the dust is recovered ?—We are beginning to do that.

14550. You are quite satisfied that it ought to be done ? —I am doing it.

14551. And you think that when it has been done there will be very little trouble with dust going down from the screens ?—I think there should not be much trouble.

14552. Then you earnestly represent that the existing Rules should be fewer and more simple. I do not know whether it would be possible to have some synopsis or a very short summary of the Rules, and refer the men to the Rules if they want to know more about the subject. But I suppose all the Rules are important, although they are very numerous. How do you propose to shorten them ? Surely almost every word in them applies to some mining operation ?—Yes, but I cannot help thinking they could be simplified.

14553. You suggest with regard to shot-firing that " No shot should be fired on any main haulage way without the written consent of the manager or under-manager." Do you mean that the manager or under-manager should give a general instruction to some mining official that he is only to permit shots under certain circumstances, or that before any shot is fired at all in a main haulage way the firing of that particular shot should be agreed to by the manager ?—I think in dusty mines that particular shot should be dealt with in that way.

Digitized by Google

14554. You think that for at least 50 yards the main haulage roads should be kept in a damp condition. With regard to such zones and the length of zone that is necessary to stop an explosion, have you formed any opinion as to whether an explosion is better stopped by a dry and dusty zone than by a watered zone? Do you think you ought to have a greater length of a dry and dusty zone to stop an explosion than of a watered zone?—If the zone is dustless, the same length would do.

14555. You do not think the water itself has anything to do with it?—Only in the fact that it makes it dustless, and of course, to some extent, cooler.

14556. But then surely, would not the water necessarily lay the dust rather better than any amount of cleaning could deal with it?—Well, I am assuming that when you say "dustless" you mean there is no dust.

14557. It would be as dustless as you can reasonably make it, but you cannot get a completely dustless zone, can you, except by watering?—You can by watering.

14558. But you cannot by cleaning, I suppose?—I am not aware that you can. I suppose you could.

14559. Therefore I suppose you would say that, where it is possible to do so, it would be better to have watered zones than dry and dusty zones?—If you said you must have a dustless zone, that could only bear one interpretation, and you would let them find out how to make the dustless zone. If you said to me "You must have a dustless zone," I should water it, but I would not prevent anyone else doing it in another way if they could do it.

14560. But you do not think they could do it in any other way?—I do not think any other way would be so cheap and practicable. There would be other ways which might be ridiculous. I have suggested another way myself—it is not altogether ridiculous, but I would not like to do it without experiment—and that is with an oily substance.

14561. That is pretty much the same thing as watering; you would lick up the dust by some substance. But I was asking whether, in your opinion, it would be possible to make a zone dustless simply by sweeping?—No, I do not think it would be. In that case, if you were sweeping, you might produce by a longer zone some safety equal to that produced by a short wet zone. I think that is possible.

14562. You would have to have a much longer zone?—Yes, it would be very difficult to do.

14562A. (*Mr. Cunynghame.*) I understand you think that the rules are rather too many, and that they go into too great detail, or rather, I should say, they order things to be done which are not necessary. Do you go as far as that? You use these words: "I doubt the wisdom of training men to be taken care of rather than teaching them to take care of themselves"?—Yes.

14563. Does that mean to say that there are any of the rules that are superfluous in matter?—Yes, I think some of our rules are superfluous.

14564. Will you name one?—I think the Timbering Rules are; systematic timbering, I think, has brought about no improvement.

14565. Would you strengthen the rule or take it away altogether?—I would not have had it.

14566. Now will you name another one?—Well, I should not like to name them from memory; I would rather study the subject.

14567. I put it to you that I do not think you would find one which you could really take away?—If you will give me time, I think I should; but I certainly am not prepared to specify any particular rule now.

14568. If that is so, what you want is a codification of the rules, and their expression in simple language and good arrangement?—Yes, the simpler the better.

14569. The arrangement is very bad; I quite agree with you there?—I think so.

14570. It is mixed up, but that has been to a large extent the effect of circumstances, and the way in which the rules have had to be brought in?—I think there could be little improvement on the old Act, if it was properly carried out.

14571. Do you not think that the Special Rules in districts go beyond the Act very much?—Yes; but then the Special Rules are provisions under the old Act.

14572. At all events, there is this to be said, that I doubt very much whether when a workman breaks a rule he does not know that he is doing something wrong. Is that not so? Supposing you take a walk in the park, and you do anything unreasonable, you are probably breaking one of the rules of the County Council, although you probably do not know the rule?—I should think you probably are, but you do not know it.

14573. It is not necessary to know the text of the County Council rule to know that you are not to tread on the flower-beds?—Well, that is a little too obvious, is it not?

14574. It is exactly like loading and stemming a shot with coal dust?—I think not. You are not to stem a shot with coal dust; but, on the other hand, I am not by any means certain that all the miners in all the pits know that.

14575. Do you mean that they do not know the danger of it?—If the miners of this country thought dust was as dangerous as gunpowder, and knew as much about dust as they do about gunpowder, we should not have these accidents.

14576. But that is rather an argument in favour of the rule being made clearer and more stringent with regard to stemming with coal dust, not for taking the rule away?—No; it is an argument for teaching the men the danger of coal dust.

14577. The only way in which the Home Office can do it is by making a rule, I suppose?—I do not know what the powers of the Home Office are, but I think men and boys may be taught more.

14578. Now with regard to watering the dust, you do not maintain, I suppose, that by watering the dust and treading it down it will remain a compact mass after the water has evaporated?—Yes, for a time.

14579. After the water has evaporated?—After the water has evaporated.

14580. Without any binding material at all?—Without any binding material whatever.

14581. That is curious. I should have thought that if you watered a mass of dusty powder in a coal mine and stamped it and patted it down and then the water evaporated, the first boot of a man coming along there would make the whole place as dusty as before?—I do not think so. The first boot of a man coming along would break it up, but it would take a good many boots to break it up as fine as it had been.

14582-3. You instanced a tennis-court. You have never seen a tennis-court made with powdered coal dust beaten down with water?—I was referring to cinder courts that are made with nothing but cinders and water and beaten down.

14584. But cinder dust is a different thing from coal dust, is it not?—I do not think it is very different in that respect.

14585. They would be extremely dusty cinder courts unless they were on a clay soil and the soil bound them?—They become dusty after a time.

14586. They become dusty after a day if there is no clay?—I do not think so—not sufficiently dusty to make dust which, if it were coal dust, would cause an explosion.

14587. (*Sir Lindsay Wood.*) I think your theory with regard to the explosion of coal dust is that it is rather the continuance of the running fire of the coal dust?—Yes.

14588. Not an explosion?—Not an instantaneous explosion by any means, any more than firedamp always is. I have had firedamp fire over my head; it might have been explosive, but it was not.

14589. It does require a certain amount of oxygen to keep the up-running fire of the coal dust?—Yes, and I think that the more condensed it becomes the more violent—the more condensed the atmosphere becomes in front of the explosion—because it must have an enormous pressure; an explosion cannot turn the intake air current and reverse it at a huge speed without having first produced a huge pressure.

14590. But that is confining a larger amount of oxygen into a smaller space to assist the combustion of the gases in the coal dust?—That is so.

14591. Therefore a door, as you exemplified, which prevented the dust rising up into the oxygen would stop the flame from going forward?—That is so.

14592. If the explosion were very great or the expansion very great, it might light the dust and raise the dust through the door after it was blown down. It would depend upon the volume of fire and the explosion?—Yes, it would depend entirely upon circumstances.

14593. The mere fact of a door being there might not prevent it?—It might not; but I cannot say that I have

Digitized by Google

Mr. W. C. Blackett.

6 Mar. 1907.

ever seen an explosion develop through a door except in one or two instances, and they were doubtful.

14594. You say that the Urpeth explosion was caused by a shot being fired. Where was the shot?—There were two shots, one in each corner. There was an arch of coal left in the top and they put a shot into each side, and the deputy or someone had stemmed both those shots with coal dust, and then fired them electrically; he fired the left-hand one first, and, no doubt, that being fired by itself first, had raised not only a cloud of small dust in the face where there was already a little firedamp, but it had raised the temperature. Whether the deputy examined the place or not is very doubtful to me, but he fired the right-hand one into conditions that had been made more dangerous, and the explosion occurred. I believe if he had fired them both simultaneously the accident would not have happened.

14595. Were those shots in the coal face?—They were in the coal face.

14596. Was it a board or long-wall?—It was a "whole" place.

14597. In that case there was sufficient coal dust in the face to cause the spread of the explosion out-bye?—It helped the firedamp that was there. There was firedamp.

14598. There was gas?—Yes. I do not think it could have fired without the gas. In that case I may say the explosion travelled out of three galleries; in one gallery 14 yards of damp stopped it; in another gallery, 40 yards stopped it; and in a third gallery, 50 yards stopped it.

14599. That is to say, those distances of damp space?—Yes.

14600. You say in Paragraph 19 of your Statement that even with a naked light itself coal dust might be set on fire?—Yes.

14601. You say that "It is within the bounds of possibility to have an inflammation of dust in a mine by a naked light"?—I think, perhaps, it might be possible, but I cannot conceive the circumstances arising which would make it possible.

14602. But you say "by a naked light." Of course it depends upon the size of the naked light?—Yes.

14603. Would an ordinary safety lamp light cause an explosion?—No. You could not get an explosion of coal dust by any possible means through a safety lamp.

14604. You would have to have a sufficiently large volume of flame to cause the heat to set the coal dust on fire?—That was so in the hopper that was fired at Brancepeth. But if you could get a circumstance like that down a pit (which I do not think is possible) a naked light might be sufficient to fire the dust.

14605. What was the size of the naked light at Brancepeth?—It was one of those large-flaming hand lamps—a torch lamp, I think.

14606. Under ordinary circumstances such a light as would be in a mine, that is to say either a candle or a safety lamp wick, would not be likely to fire dust by itself?—No, I do not think it is possible.

14607. You say that disobedience of the rules could never be prevented. Is not that rather a strong statement?—No, I do not think disobedience will ever be prevented.

14608. It can be reduced to a minimum, at any rate?—It is just human nature I am thinking about.

14609. But I think you will admit that the rules are at the present day much more strictly adhered to than they were?—I think the more the men are getting to know about these things and the more educated they are becoming, the better they are observing the rules.

14610. Do you think a more strict adherence to the rules would prevent many, if not all, of the explosions which now take place?—I have not known of an explosion which would have taken place if our rules as they are now had been carried out.

14611. If the present rules had been carried out none of the explosions, say during the last 10 years, would have occurred?—I have not seen one anywhere.

14612. Irrespective of the prevention of coal dust?—Yes.

14613. You mean that the source of the explosion—the source which caused these deaths—could have been prevented if the rules had been adhered to?—I think so, unless an accident occurred. Supposing, for instance, that a man was going to fire a shot and he carefully watered all his gallery where the shot was, and he prepared his shots, and then retired outside of the wet area to where it was dusty, and that by some means he accidentally lit up the explosive which he was not using, then I think the accidental lighting of the explosive might cause it. Whether it is possible, in these days of high explosives, detonators, and so on, to do that I very gravely doubt. I do not think it is. But in the Brancepeth explosion I believe that is what occurred, although other people differ from me. The rule, you see, could not have covered an accident of that kind.

14614. In that case you mean there was an accidental firing of a cartridge?—I am firmly convinced of that.

14615. And you think that was the cause of the explosion?—That the whole contents of a cartridge box went off at the limit of where the watering had been done. I gave that evidence at the Brancepeth inquest.

14616. Was it possible to ascertain how the cartridge case got fired?—It was not possible to ascertain that; but they had candles with them—they were using candles, perfectly within their rights. So that it is not difficult to conceive how gunpowder might become ignited in the presence of a candle.

14617. But that would be a very exceptional case?—That would be a very exceptional case, and with these high explosives it could not arise.

14618. Then you say that you think in some mines watering could be done without any danger?—I think so, certainly.

14619-20. Are those mines which are at all likely to be ones which would have an explosion?—In some of them it is quite likely.

14621. But the dry and dusty mines are those which are more likely to have an explosion occurring in them?—Yes, the very dry and dusty mines, certainly.

14622. With regard to the spray which you showed us, you say it was used at two or three different places in the mine?—Yes.

14623. What length of galleries does such a spray cover?—Only a few yards; not more than half the length of this room.

14624. Would that be sufficient to prevent the dust rising in the case of an explosion?—Yes, I think so. It would at that point.

14625. At that particular point?—Yes.

14626. But if an explosion took place, say, 200 yards away from that?—I think it would not pass that point. The air current was carrying the moisture considerably further than the area of the spray you spoke of.

14627. Then you rather infer that those ought to be applied in zones, not through the whole length of the haulage-way? — Not where there is any danger from watering; the zones would be quite efficient.

14628. I see a very large proportion of explosions occur from naked lights?—Yes.

14629. Would you make more stringent rules for the prevention of the use of naked lights than the rule which exists?—Well, the rule as it is at present says that you have to employ a safety lamp where there is likely to be gas.

14630. I notice that in the Inspector's Returns, out of 183 fatal explosions which occurred in the last 10 years, up to 1905, 144 were occasioned by naked lights?—Yes.

14631. It seemed to me that rather showed that some stronger rule is required for the prevention of the use of naked lights. You see the present rule is very open, because it says "Any place in a mine in which there is likely to be any such quantity of inflammable gas as to render the use of naked lights dangerous"?—Yes.

14632. Could not that rule be made more stringent so as to prevent so many accidents occurring from naked lights?—It might in the case of dusty mines; but if that was intelligently carried out, even that would be sufficient.

14633. Why in the case of dusty mines?—Because I understand you are trying to guard against explosions from coal dust.

14634. But my impression is that we ought to stop the explosion altogether?—You mean to stop an explosion of gas altogether?

14635. Stop the accident altogether.—The accident from gas alone?

14636. The reason of dealing with coal dust is that it causes the explosion to be more deadly?—It intensifies it.

14637. But it does not stop the explosion?—Certainly not.

Digitized by Google

14638. And probably it does not cause the explosion?—What I mean is that in all mines they know when there is likely to be gas. If there has been gas it must be likely that there will be gas again, and if a manager has had experience of gas in a place before, he ought to be able to say to himself, "If there is likely to be gas again I must put in safety lamps." It might perhaps be made more definite.

14639. But the fact is that there is a very large number of accidents from explosions occurring from naked lights?—Yes, so I read: I have not had experience of it myself.

14640. Do you think that the Rule might be strengthened?—It could be strengthened by saying, instead of "where there is likely to be," "wherever there has been gas found."

14641. I am not going into the actual wording of it, but I am dealing with the question of whether it may not be made stronger, seeing that a very large proportion of accidents do occur from the use of naked lights?—Yes. It is rather difficult to draw a line. If you have a mine which is so naturally wet throughout and in which you very very seldom see any gas at all, you may wish to preserve the use of candles in order to maintain a greater degree of safety from falls: a man examines his place so much more easily where there is a good light, and so on. You might think there is not so much likelihood of a dangerous quantity of gas there, although you might possibly find it. In that case I should have to balance in my mind the probabilities of the two dangers, and see which was likely to be the greater. I should not like to deprive them of the extra safety obtained by the better light.

14642. Take the question of the coal dust: would you make it compulsory to have zones in every roadway in the whole of the mines throughout the kingdom, watered two or three times a week, or the whole length of your wagonways watered every 24 hours, in mines in which you have not had an explosion for perhaps 40 or 50 years?—In those cases would there be shot-firing anywhere in the pit?

14643. No, there might not be?—No shot-firing and no gas ever seen; I should think the mine could be worked reasonably safely without watering, but then watering might be done for sanitary purposes only.

14644. Well, that is rather a doubtful point, whether it is sanitary or insanitary to water a mine?—I do not know. I myself should water some parts of the mine for sanitary reasons.

14645-6. Rather than go to the source of the accident? I am putting it in this way: the returns show that there are 144 fatal explosions from the use of naked lights out of 183 during the 10 years: now if there had been no naked lights in any of those mines you would have stopped 144 explosions out of 183 irrespective of coal dust?—Yes, but we have mines where there never is and never has been firedamp, and never could be. If you legislate for some it might be that you would go and introduce a new danger. I have portions of mines, drifts, and so on, where it is a physical impossibility to have any firedamp.

14647. I only want to know whether, in your view, the Rule could be altered so as to prevent those 144 accidents?—The only suggestion I can make is that where you had discovered gas you could strengthen that Rule by saying that a safety lamp should be employed in that part—where gas had once been discovered.

14648. And as a further safeguard against accident you would think it desirable that all dry and dusty mines should be watered?—To some extent, yes.

14649. (*Mr. Enoch Edwards.*) With reference to shot-firing on the main haulage road, you suggest that it should not be done without the written consent of the manager?—In dry and dusty mines, yes; I most certainly think that should be so.

14650. But ordinarily a shot-lighter is commissioned to fire shots, according to his judgment, everywhere?—No—where instructed. A shot-firer, because he is licensed to fire shots, is not licensed to go and fire shots where he likes. To begin with he has to examine the place and see that it is free from gas.

14651. Yes; having examined it and found it free from gas, he has full authority to fire shots?—No, I think not; he would not be expected to fire on the main haulage ways.

14652. I am not for the moment referring to the main haulage ways, but he would fire shots—he is specially appointed for that purpose?—To the work for which he is sent.

14653. That is to fire shots ordinarily in the colliers' working place?—If he knew that shots were to be fired. For instance, supposing you were firing shots at a coal face, then the shot-firer would be licensed to fire shots anywhere on the coal face; but supposing no shot were ever fired on the coal face a shot-firer, because he was licensed to fire, would not be allowed to go and fire one at the coal face.

14654. In that case he would not fire one at the coal face if he was not licensed to?—He ought not to.

14655. Do you mean that the same person should fire those shots in the haulage road who ordinarily fires the shots in the working places?—If he had permission from the manager.

14656. And you think that permission should be given in writing?—Yes, it would perhaps be better to give it in writing.

14657. You would say "his written consent"?—Yes. That is the order that has been given in our own collieries.

14658. That is to say for that particular shot?—For that particular shot. If a dry and dusty haulage way existed I think he ought to have written permission to fire the shot.

14659. Would it not be necessary for the manager to see the place?—I do not know that it would.

14660. How is the manager to give his consent with the full knowledge of all those circumstances, unless he sees it: what value would his consent in writing be if he has not seen the place?—Do you mean that he should specially see the place?

14661. Take the case of a main haulage road which is dry and dusty, and in which you are going to fire shots?—The manager has seen the main haulage road dozens of times, and he knows all about it, but he need not go on purpose at that particular moment to see whether the man should fire a shot at that spot which he knows perfectly well.

14662. But you are assuming that in giving his written consent he knows something about it?—Certainly—he or the under-manager, as the case may be.

14663. I understood you to say in answer to questions which were put to you, that you had not seen an explosion which would have occurred if the rules had been observed?—Unless it was at Brancepeth. The Brancepeth explosion would not have occurred if the rules of to-day had been observed there.

14664. When you say you have not seen an explosion which would have occurred if the rules had been observed, you refer to those cases within your own knowledge?—Yes—that is all.

14665. You do not give it any wider interpretation?—No, certainly not.

14666. Sir Lindsay Wood has called your attention to the number of explosions caused by naked lights?—Yes.

14667. Do you suggest that in those cases if candles were taken out and lamps put in, you would have a greater number of accidents from falls of roof?—Well, it would be difficult to prove that.

14668. But you have said as much, have you not?—No, I said that I thought the tendency would be that way. A man cannot examine his roof quite so well with a safety lamp as he can with a candle. I know that myself.

14669. Are there any statistics to prove that the number of accidents is greater?—I do not know.

14670. Would you be surprised to learn that they are not greater from falls of roof where lamps are used?—I should.

14671. Do you suggest that there are a number of mines that never have been, and never could, under any conditions, be dangerous from the use of candles?—Yes, it is not a suggestion, but a statement.

14672. Would it be too much to assume that most of these mines in which accidents happened with naked lights were thought to be safe pits?—I should think so, but I have not seen those pits.

14673. But you have heard the statistics read by Sir Lindsay Wood showing that a great number of accidents occurred by the use of candles?—Yes.

14674. Would it be safe to assume that they were regarded as safe collieries to work with candles?—I presume so.

14675. You do not think they would work them unless they were?—I do not think so.

Digitized by Google

Mr. W. C. Blackett.

6 Mar. 1907.

(*Sir Lindsay Wood.*) I used the expression "naked lights." I did not say "candles." It is on the inspectors' returns as "naked lights." It may have been that a lamp-top was taken off, or something of that sort.

14676. (*Mr. Enoch Edwards.*) Quite so. I understood you to say that in all cases you would have watered zones?—I should, myself.

14677. You personally would do so?—Yes.

14678. It would be more safe to water them?—I think it would be easier—a more practicable thing for the men to do.

14679. If it is found impossible to get a watered zone, what is the next best course?—To prohibit shot-firing.

14680. I understood you to suggest that it was possible to make a dustless zone without watering?—It must be very difficult to make a dustless zone without water, or without some other similar means.

14681. If you had a brick archway, would it be possible? That has been suggested to us. Have you had any experience of that?—Do you mean of putting arching in?

14682. Yes.—Yes, but not for the purposes of watering. But even a brick arch or a white-washed surface would hold dust; whether it would hold sufficient or not is a question I gravely doubt. But when you say "dustless," you mean dustless, I understand. I am not meaning that there is not sufficient dust to fire an explosion. I am taking it literally.

14683. Of course the idea is to take away anything that would feed an explosion and prevent it spreading?—Quite so.

14684. When we talk about a dustless zone, that means a zone which would be sufficiently dustless so that it would not feed an explosion; that is rather what is meant?—Quite so. One of the peculiarities of the wording of the Act, I think, is that it speaks of the place being dusty although you have watered it.

14685. (*Mr. Ratcliffe Ellis.*) What are you referring to?—The 1887 Act, I think it is, which speaks of a dusty place, and then you treat it as a dusty place even after you have watered it. I mean to say, if you go into a place and find it naturally wet, then you can do certain things; but if you go in and make it equally wet you cannot do the same things; you have to observe further precautions. Well, it is a little anomaly.

14686. Have you the Act which you are referring to before you?—The Act says: "If the place where a shot is to be fired is dry and dusty, then the shot shall not be fired unless.... the place of firing and all contiguous places within a radius of 20 yards therefrom are at the time of firing in a wet state," and so on. Then you have to use all sorts of precautions.

14687. Will you just deal with that as you go along. What part of the Act is that?—It is (*h*) and (*i*) of General Rule 12.

14688. Now what is your objection to that?—I am not exactly raising an objection. I am pointing out a little anomaly, that if you find that place to be naturally wet you have not to carry out these precautions; but if you make it wet, then you have.

14689. There is a difference between being naturally wet and artificially wet?—Yes.

14690. Will you read the particular part you are commenting upon now?—"If a place where a shot is to be fired is dry and dusty, then the shot shall not be fired unless one of the following conditions is observed, that is to say, (1) Unless the place of firing and all contiguous accessible places within a radius of 20 yards therefrom are at the time of firing in a wet state from thorough watering or other treatment equivalent to watering," and so on; then you have certain other conditions.

14691. No, you are not to fire the shot at all, you see, so far as you have got now, "Unless the place of firing and all contiguous accessible places within a radius of 20 yards therefrom are at the time of firing in a wet state from thorough watering or other treatment equivalent to watering, in all parts where dust is lodged, whether roof, floor or sides." Up to that point you have no objection to make; that is quite right, is it not?—Yes.

14692. I want to get to the point that you object to?—"If such dry and dusty place is part of a main haulage road."

14693. That is (*i.*): "If such dry and dusty place is part of a main haulage road, or is a place contiguous thereto, and showing dust adhering to the roof and sides, no shot shall be fired there unless," and so on. If that condition exists no shot is to be fired there unless both the conditions have been observed: that is that it must be made wet, and if it is made wet, according to your view it is safe?—Yes.

14694. What do you suggest is wrong about these Regulations?—I am not saying they are wrong; I am saying they are rather confusing and anomalous, because you first find your dry and dusty place, and then you wet it; but even after you have wetted it, if it is on a main haulage road you still have to carry out these other provisos.

14695. Because it is a more dangerous place?—Quite so.

14696. You do not object to that?—No, I do not; but if you have found it wet to begin with, then you need not do these things.

14697. If it is wet to begin with it is wet already?—But there is a difference made between finding it wet and making it wet.

14698. Will you show me the exact words which you are criticising now?—Those in (*h*) and (*i*).

14699. But (*i.*) is "If such dry and dusty place is part of a main haulage road, or is a place contiguous thereto, and showing the dust adhering to the roof and sides, no shot shall be fired there unless (1) both the conditions mentioned in sub-head (*h*) have been observed"?—Yes, unless you have watered it.

14700. Unless it is wet with thorough watering?—Yes.

14701. "Or (2) unless such one of the conditions mentioned in sub-head (*h*) as may be applicable to the particular place has been observed; and moreover all workmen have been removed from the seam in which the shot is to be fired, and from all seams communicating with the shaft on the same level, except the men engaged in firing the shot," and so on. I do not see where it is that you draw a distinction between finding it wet and making it wet?—I will try and explain. Supposing I went in knowing that men were coming in to fire shots, and I found this place dry, and I went and wetted it thoroughly, and then the men came in to fire the shots and found it wet, they would not, under the strict wording of the Rule, have any of those precautions to carry out with regard to the workmen being removed, as I who made it wet would.

14702. It is not necessary then. Are you speaking about the face or the main haulage road?—I am speaking about the place on the main haulage road, to show there is a little anomaly—that is all.

14703. (*Chairman.*) I do not understand that, because you say that if the place is originally found to be wet, you need not take any of these precautions in the main haulage road; but that is not so, because under the Act on a main haulage road whether the place is wet or not you must have certain additional precautions which are not necessary elsewhere: you must use a permitted explosive, for instance?—Yes, under the Order, but not under Rule 12 of the Act of 1887.

14704. You have to remove all the workmen from the mine I think. If you want to fire a shot in a main haulage road you must do one of two things, whether the place is wet originally or whether it is not; you must either take all the men away, as I understand, or else you must use a permitted explosive?—In a wet haulage road or in a wet mine?

14705. In a haulage road of any kind, whether it is wet or whether it is dry?—I do not think so, under the Act of 1887.

14706. Section 3 of the Explosives Order issued on the 19th December last year, provides: "In every coal mine the use of any explosive is prohibited in the main haulage roads and in the intakes"—that is in the particular places—"unless all workmen have been removed." It does not say anything about its being dry and dusty. You must either remove the men, of if you do not remove the men you must use a permitted explosive, and you must wet where the place is not naturally wet. But in the main haulage roads and in the intakes it is perfectly clear that the mere fact of the road being wet is not of itself sufficient, as it is in other places, to enable you to do away with all other precautions. That seems to be the difference. I do not see myself that there is any ambiguity about it?—It is quite clear in the Order.

14707. (*Mr. Ratcliffe Ellis.*) We will leave the question of shot-firing for the present. Have you done anything in the way of ascertaining whether you can classify dust?—I have done nothing myself.

Digitized by Google

14708. Are you familiar with any experiments which have been made in that direction?—No. I think dust probably could be classified, but I do not know that it would be practicable.

14709. Do you think there is any organic dust that is harmless?—I do not.

14710. There is some that is exceedingly dangerous?—There is some that is exceedingly dangerous.

14711. Do you know whether there is one class of dust which is more dangerous than another?—I should think there is.

14712. But you know nothing about that yourself; you have not examined it chemically?—In the explosion at Urpeth——

14713. Is that the last explosion?—That is the last explosion—the inflammation, or whatever it was, that had taken place had generated sufficient heat to take from the dust and the small coal that was there the lightest gas, and melted what was left, and in the melted state it flung itself upon the props and caked there, and took the casts of the props. We had dust analysed similar to that existing before it was fired: Professor Bedson analysed the coal on the props, and the difference in the analyses we take to represent what is gone. We have those analyses.

14714. What was the result; what was the difference between the dust before the explosion and the dust after the explosion?—I have that information here. We took three dusts: we took the dust that we found on the in-bye side of the timber—that was the dust that had been flung in a melted state against the in-bye side of the timber; then we took the dust we found on the out-bye side of the timber that had been deposited as the current returned on the cooling gases; then there was a very extraordinary thick deposit of oily sooty matter lying on the horizontal surfaces, almost like a blanket, which would crease up like a blanket, and did not soil your hands very much—in fact it seemed to me to be a condensed rain of oily soot: we took that and had that analysed, and we analysed the original dust. We established a ratio of volatile matter to fixed carbon; and the ratio of volatile matter for the coal as we took it to be before the explosion was from 1 to 2·03.

14715. What was the volatile matter?—The volatile matter was 1 and the fixed carbon was 2·03. For that which we got off the screens off the surface, the volatile matter was 1 and the fixed carbon was 2·17.

14716. The first that you analysed was the dust down the pit before it had been affected by the explosion?—Yes.

14717. That was compared with the dust on the screens, and that was the difference. The volatile matter was rather less in quantity?—The volatile matter was rather greater down the pit than at the surface.

14718. Down below it was rather greater than on the surface?—Yes.

14719. By the way, was there any further analysis of that volatile matter?—Not that I am aware of; I have not it, at any rate. Then we got the dust that was flung against the in-bye side of the props.

14720. That is dust affected by the explosion?—After the explosion. The ratio became 1 of volatile matter to 4 of fixed carbon.

14721. What was that volatile matter which was left, do you know; was that further analysed?—I have not an analysis of it.

14722. You have not the comparison between what the volatile matter was in the dust before the explosion and what it was after the explosion?—I have not that; I have only the total. Then the next was the dust that had come back and come on to the props as the gases condensed inside—the backlash, or whatever they call it. It was 1 to 3·28; so that the volatile matter had increased.

14723. That is to say the volatile matter is the greatest in the dust before the explosion, and it is the least in the dust that is more immediately affected by the explosion?—Yes.

14724. And there is a larger quantity in the later dust which is not so much affected by the explosion than there is in the dust which is affected by the explosion?—There is one further fact I should state, as this is a matter of interest; the extraordinary blanket-like, sooty matter that we found condensed on these horizontal surfaces contained a large amount of volatile matter, considering that it was after the explosion, because it was 1 to 2·63.

14725. What conclusion do you draw from this?—The conclusion that I draw is that the lightest gases and the most easily distilled—methane, I think it would be—are those that caused the mischief of the explosion.

14726. But why do you come to that conclusion? You find certain results in this dust after the explosion—a certain amount of volatile matter has gone away?—Yes.

14727. Do you think that analysis justifies the conclusion which you are now giving?—Yes; it is what you would expect.

14728. Is this the only dust that you have ever had analysed in this way?—I have seen accounts of other dust.

14729. Have you had an opportunity of comparing the result?—No, I have not compared it.

14730. So that you do not know how far this is like other dusts, or different from other dusts?—No, I am not prepared to say at this moment.

14731. Then your view about dust generally is this, that some is more dangerous than another, but that all is more or less dangerous?—That is my opinion. I treat them all as dangerous.

14732. What is your definition of a fiery mine?—I should find it very hard indeed to give a definition of a fiery mine.

14733. But in your own mind what would you look upon as a fiery mine?—I would look upon a mine where the working places generally gave off firedamp as being a fiery mine.

14734. To any extent?—To any extent.

14735. There are some mines in which you have said, I think, that it was practically impossible for that to happen?—Yes.

14736. Where are those mines?—We have them in Durham. I have one or two under my own supervision.

14737. In which you have never seen gas?—Never seen it, and could not see it, as I say.

14738. I understand you when you say you have never seen it, but not when you say you could not see it?—Because it is against all my experience, and it does not seem to be possible.

14739. But are you really concluding that because you have never seen it?—I have never seen it and never heard of it.

14740. Is that the only reason you have for concluding that there never can be any gas—because you have never seen it and never heard of it?—Well, they are so near the surface that the prevailing gas appears to be carbonic acid gas.

14741. That may be the reason. What is the distance from the surface?—They are drifts in the hillside that I am speaking of; but if you go into Northumberland, with which I am not so well acquainted, then you get a class of mine that does not seem to have it.

14742. But I wish to get from you not merely your experience in never having seen it, but whether there is any other scientific reason which you can give why gas should not be found there at any time at all. Has proximity to the surface anything to do with it?—Yes. I think the reason is that as the gas has been made it has been possible for it to leave.

14743. Mr. Edwards has put it to you that you have heard of explosions in mines where gas has never been seen or heard of?—I have.

14744. Have you one in your mind now?—Do you mean in the whole mine or in the haulage ways?

14745. I mean explosions in mines where it has been said, "This is a perfectly safe place; we have always worked with naked lights and gas has never been seen or heard of."—Where the explosion occurred?

14746. Yes.—The explosion at Wingate was one such case, in which no one had ever heard of gas on the haulage way where the explosion occurred.

14747. Are you familiar with the colliery at Wingate?—No. I was there after the explosion.

14748. (*Sir Lindsay Wood.*) Is there not gas in the mine itself?—I think so—in other parts of the mine, but not in that part.

14749. (*Mr. Ratcliffe Ellis.*) Do you know whether explosions have ever happened in one of those safe places where gas has never been heard of before?—You mean never in the mine?

Digitized by Google

Mr. W. C. Blackett.

6 Mar. 1907.

14750. Yes, never in the mine?—No, I cannot say that I myself know of it for a certainty.

14751. In describing what a fiery mine is, would you consider it a sufficient definition if it came within the clause in the Mines Regulation Act requiring the use of lamps, that is General Rule 8?—Yes, I think so.

14752. That rule says, "In any place in a mine in which there is likely to be any such quantity of inflammable gas as to render the use of naked lights dangerous." That is your definition of a fiery mine?—Yes, I think so.

14753. Do you think, as Sir Lindsay Wood has put to you, that that is quite enough?—It is so difficult to answer a question like that. You mean one person might say that a certain mine was not likely to be dangerous and another person might say it was likely to be dangerous?

14754. I do?—That is the difficulty.

14755. But what is your opinion, looking at it in that way? You have exactly mentioned what the difficulty is: that one man may think a mine is likely to be dangerous and another may not. Do you think that is sufficiently definite?—Yes, it would be sufficiently definite to me. I mean if I were the person who was going to interpret it it would be sufficiently definite to me.

14756. Will you kindly tell me what interpretation you would put upon it if you were going to interpret it?—If I found gas myself in any of these portions of the mine—

14757. In which portion?—In a district of a mine that had a separate air current.

14758. A separate ventilating district?—A separate ventilating district. If I found gas there in a dangerous quantity——

14759. Then we get to the point: What would you consider a dangerous quantity?—A quantity that if it was lit up would hurt the man who lit it.

14760. Would you put that forward as a rule?—Well, I should have to take a good deal more consideration of it than you are allowing me to give at the moment. But I have lit up gas in a pit which has not hurt me.

14761. You would not like to do it oftener than was necessary, I suppose?—No, I should not. But you see, supposing you are firing a shot at a "trouble," you may have a little gas come off—just a little pocket—and it lights up and goes out again—it is done with.

14762–3. I am going to suggest another definition to you. Have you in the Special Rules for your district any further provision than is contained in the General Rules with reference to safety lamps?—Yes.

14764. What do you think of this: "The manager shall see all locked safety lamps only are used in every coal seam of the mine to which these Special Rules apply, in which an explosion of inflammable gas, causing any personal injury whatever, has occurred within the previous 12 months, or in which, within the same period, such a quantity of inflammable gas has been found as to render the use of naked lights dangerous." You see that rule provides for two cases: where any personal injury has been caused by an explosion of gas within the preceding 12 months, or the words of the General Rule. Those are the Lancashire Rules?—Well, I am putting the construction on to a district; that is all the difference. This is a seam.

14765. I ask you do you think, or do you not think, that it would be conducive to safety if the General Rule was amended in the direction of that Special Rule?—Yes.

14766. That where there had been any accident from an explosion of gas to any person within the preceding 12 months safety lamps should be required?—In the district?

14767. In a ventilating district?—I should do it myself.

14768. Would you confine it in such a case to a particular ventilating district, or would you apply it to the whole mine?—I think I should apply it to the ventilating district.

14769–70. Why?—You are assuming, you know, that it is only once in 12 months.

14771. But this is the mine the rule deals with, not a ventilating district. If gas has been found within the mine and any person has been injured by an explosion of gas in the mine, have you any reason for limiting the operation of the rule to the ventilating district of the mine?—Yes, because I think that is all that is necessary. You are making it wider than this rule does: you mention "mine," but this rule deals with "seam."

14772. I mean "seam"?—I am making it ventilating district in a seam for exactly the same reasons as you are making it seam in a mine.

14773. You think a rule of that sort might be adopted, but you would limit it to the ventilating district of the seam?—Yes.

14774. You are familiar, of course, with the regulations as to shot-firing, and you say that you think no shots should be fired in the main roads. Do you extend that to all the main roads or merely to the haulage roads?—The haulage roads.

14775. Why do you limit it to the haulage roads?—Because the dust on the haulage roads is the more dangerous dust.

14776. You think that no shots should be fired without the personal direction of the manager?—Without the permission of the manager or the under-manager.

14777. What do you mean by "permission"?—I mean he must first be asked if they can fire the shot at the particular point, and he must say "Yes."

14778. But would you require that he should not only be told, "We want to take a piece down in yonder road, may we fire the shot?" and that he should say "Yes," but that circumstances should be brought before him in detail as to what the shot was to do?—Yes. I cannot conceive of a manager giving such permission unless he had considered the circumstances.

14779. You intend it to extend to that, that he must give the permission after being acquainted with the circumstances?—Yes.

14780. Would you leave it then to the shot-firer to carry out those directions, or would you have some supervision when the shot was being fired and arrangements made for it, and watering done?—I cannot see what difference there would be, whether you left it to the shot-firer or to someone else; it is a personal thing, and if your shot-firer is a good man he ought to be as good as another man.

14781. I gather that you think it is the special duty of the shot-firer to do that, and he ought to know as much about it as the manager or under-manager, or anybody else?—Certainly.

14782. And on permission being given and instructions being given to him, he ought to be left to carry them out, you think?—Most certainly.

14783. Have you any Rules with regard to shot-firing at all in your Special Rules?—Yes.

14784. Have you any provision about firing more than one shot at a time?—No, not that I can recollect.

14785. Do you think it is desirable that there should be such a provision, that you should not fire more than one shot at a time?—I cannot see why we should not. At Urpeth I firmly believe that if both the shots had been fired together there would have been no explosion. The explosion at Urpeth was, to my mind, caused because one shot was fired first and then the next one was fired.

14786. But when I put it to you that they should not be fired at the same time, I mean have you any provision that there should be a sufficient interval between the two, so that an inspection might be made as to the result of the first shot?—Yes.

14787. Have you a Rule as to that?—Well, I think that would be in the Act.

14788. Will you look at it and see whether you can find it?—It is the Rule that before a shot is fired he has to examine the place.

14789. Yes, I know that; but do you understand that to mean that after one shot has been fired, a thorough examination should be made before another shot is fired?—Certainly.

14790–1. Do you mean that two or three shots must not be fired together?—Certainly.

14792. I want you to point out to me the Rule you refer to?—"No shot shall be fired except by or under the direction of a competent person appointed by the owner, agent or manager of the mine, and such person shall not fire the shot, or allow it to be fired, until he has examined both the place itself where the shot is to be fired and all contiguous accessible places of the same seam within a radius of twenty yards, and has found such place safe for firing." It only mentions that in the singular—"the shot."

14793. You consider that means that only one shot shall be fired?—Yes, I should read it in that way.

14794. Is that your practice?—Yes.

Digitized by Google

14795. You suggest that that is unnecessarily stringent—that you might fire a number of shots at a time ?—Yes, I cannot see that there is any danger in that, because I have this instance before my mind.

14796. Have you any special rules with reference to the unramming of a shot ?—Yes ; we are not allowed to do that. But that point as to unramming is provided for in the Act.

14797. Yes, it is in the General Rule ; but I want to take it generally, do you think that the provisions in the Act and in your special rules, excepting as to the points you have mentioned, are sufficient to secure safety if they are observed ?—I do think so, most strongly.

14798. You have explained very fully your view with regard to the dust contributing to an explosion. Do you think that an explosion could arise from dust alone, without gas ?—Yes, without gas : well, it makes its own gas—it distils it off.

14799. As it goes along ?—Yes.

14800. You think it is quite possible to have a purely dust explosion with no gas at all ?—Yes.

14801. I gather your view is this, that the dust, so long as it is sticking to the roof or the sides, is harmless—I mean in the case of an explosion ?—Yes, if it stays there it is harmless.

14802. But in order to make it dangerous it must be in suspension ?—Yes.

14803-5. You think that if there is not a sufficient blast of air to bring it into suspension at the time the flame comes there is no danger from it ?—That is so.

14806. You are quite alive to the danger of dust in connection with this matter ?—I have for many years been alive to it ; I think it is as dangerous as gunpowder.

14807. What is the depth of the mines you are working ?—My mines in Durham are down to about 100 fathoms from the surface ; and then I have some little connection with one in Yorkshire which is down to 269 fathoms.

14808. So that the Yorkshire one is a deepish mine ?—Yes.

14809. Have you any systematic arrangements for removing the dust at all ?—Yes, we remove it, but it is not always dust when we are removing it ; it has been watered and washed down, and it is more or less ordinary dirt, so to speak.

14810. We will come to the question of watering by and bye, but you do not remove the dust before you water it at all ?—Not generally.

14811. You said you might remove it for sanitary purposes ?—We do not remove it on the main haulage way much before we water it, because we do not like to disturb it—it only goes further in-bye.

14812. I was going to say that it would put the dust in suspension and cause the mischief which you are seeking to avoid ?—Yes.

14813. You do not think it is practicable to remove dust to such an extent as to make it harmless in case there is an explosion ? Putting the question of watering aside for a moment, I wish to deal with the question of the removal of the dust.—No, I do not think it would be ordinarily practicable to remove dust without watering.

14814. I do not quite know what that means ?—I think you could apply some extravagant means probably.

14815. You mean it is not practicable in ordinary roads, for instance ?—Yes, under ordinary circumstances.

14816. Therefore if you must carry out such a removal of dust as in your view would be useful, you must have specially-prepared areas from which to remove it ?—Yes.

14817. Have you ever seen any ?—Do you mean specially-prepared areas ?

14818. Yes ?—Never.

14819. Of course that could be done ?—Do you mean that you could make a specially-prepared area from which you could remove all dust without any watering ?

14820. Yes ?—There is no doubt that it could be done.

14821. It is a question of expense, I suppose ?—Yes.

14822. Now you have no idea, and I suppose nobody has, as to the length of area that would be sufficient to stop an explosion. Can you say what length of a dustless area would stop an explosion ?—I think I have some idea.

14823. What distance do you think ?—I think 50 yards.

14824. Have you any reason for saying that ?—Yes ; because 14 yards of wet space at Urpeth stopped it, and I draw no distinction between a wet space and a dustless space.

14825. You think there should be no difference made between one and the other in point of distance ?—I do not think there should be—if it is dustless.

14826. With reference to the watering at your own collieries, you water the top of the downcast shaft ?—That is at the Yorkshire colliery which I have mentioned.

14827. What distance are your screens from the mouth of the shaft ?—They are immediately at the shaft, surrounding it.

14828. I suppose the coal that comes up gets watered to some extent also ?—The coal in the tubs ?

14829. Yes ?—Well, it would be very trifling.

14830. These sprays are close to the side of the shaft, are they ?—Yes.

14831. And they simply water the side of the shaft ?—They point into the centre of the shaft.

14832. Are they at the top of the shaft ?—Yes, close to the top of the shaft.

14833. You say you have found as a matter of fact since you have adopted that system that there is much less dust down the pit ?—There is an extraordinary difference. I should not have thought it possible unless I had seen it myself.

14834. In your roads you do the same thing to some extent, I think ?—Yes, to an increasing extent.

14835. Do you do it all through the pit ?—No. At present in Yorkshire we have only done it within 200 yards or 300 yards of the shaft. But the other watering further in has as yet only been done by the tubs. I may tell you that at that pit we are firing no shots at all.

14836. Is that the pit in which you have abandoned firing altogether in the Barnsley seam ?—Yes.

14837. Why did you give up firing ?—Because there was no necessity to fire shots ; we did not need to run unnecessary risk.

14838. With regard to zone watering, I understood you to say that you did not advocate the watering of the whole pit, but you thought the watering might be sufficient if done in zones ?—Yes.

14839. Do you think that 50 yards is enough ?—I think 50 yards would stop an explosion.

14840. You have not seen any such cases, I understand ; but there are places where they could not water ?—There are. I have seen places where they could not water ; I have heard of places.

14841. You suggested that in such cases they should not fire shots ; that is the remedy ?—That is the only remedy I can think of.

14842. It might be that they might remove the dust in those places ?—Yes.

14843. Would you leave it to the manager to say whether he should adopt the method of having his zone free from dust altogether, or that he should deal with it by watering ?—I would most certainly leave it to the manager.

14844. Would you not leave it to the manager to say whether, if these zones were prescribed, he would have a wet zone or a dry zone ?—Yes, I should leave that entirely to the manager.

14845. Have you had any experience of very deep mines ?—I have had some experience of them.

14846. Have you watered them ?—I have not had any experience of management in deep mines.

14847. Do you not think it would make it very much more arduous for the men to work in a deep and hot mine, if you watered it ?—If you saturated the air, most certainly it would.

14848. Do you think you could do such an amount of watering as to be of any use in case of explosion without making it very oppressive for the men to work ?—If you wanted to water the whole mine or the haulage way, but if you wanted to water a zone, that might be done.

14849. You say you think the human element is a very important matter ?—I do.

14850. How do you propose to teach ?—I do not see why, with our marvellous systems of education, we should not teach in the schools to begin with.

Digitized by Google

Mr. W. C. Blackett.

6 Mar. 1907.

14851. Do you mean the elementary schools?—The elementary schools; we might begin with the school-boys whom afterwards we send down the mine.

14852. You suggest that instructions should be put in the Code?—Yes.

14853. Have you any experience as a manager of an elementary school?—I have.

14854. Would you add to the Code special elementary instruction for mining pupils?—I would. I would make the education more useful than it is.

14855. At any rate, it would not be done at technical institutions; your idea is to begin at the elementary schools?—If you leave it to the technical schools you would leave it to the pupils' option whether to go to them or not. Then they do not go.

14856. But do you think it is practicable in an elementary school to have practical teaching as to the dangers of mining?—Yes. The women, boys and men, and everybody in pit villages at present know the dangers of gunpowder.

14857. You may be right, and I daresay you are, in thinking that greater care on the part of the men would make things much safer; but have you any scheme beyond the one you have just mentioned for giving instruction?—I think more informal lectures might be given to the men.

14858. There is less difficulty with regard to instructing your officials?—A good deal less difficulty; you have your officials around you from time to time, and you talk over these matters. For many years we read through the rules from time to time, and tried to remind people of everything.

14858A. (*Mr. Smillie.*) Do you consider that stemming shot-holes with coal dust is dangerous?—I do.

14859. Why?—Because of the tendency to a blown-out shot and the coal dust expanding the inflammation. Moreover, the heat of the shot would distil gas from it.

14860. Does not the stemming of the shot, supposing it is coal dust, tamp it into a hard mass?—It does.

14861. Have you ever known miners stem shot-holes with dry dust?—Yes, I have seen them doing it.

14862. Have you ever seen them wetting coal dust prior to starting to stem?—Yes.

14863. In a case of that kind does not the tamping make it into a hard mass almost as hard as the coal itself?—Yes.

14864. In that case it would only be in the event of a shot being blown out that any danger would occur—so far as the coal dust tamping is concerned?—Yes, I should think so.

14865. You said that your opinion was that all the serious explosions which you had been connected with might have been prevented, in your opinion, if the Mines Regulation Act and the Special Rules had been carried out?—Yes, if the rules which we have at present had been carried out.

14866. Carried out by whom—by the workmen or the officials?—The instances which I have most in my mind for the moment are the cases of workmen, but I am not prepared to say that officials might not be concerned.

14867. Have you known of any person being charged with a breach of the law after those explosions as being the cause of the explosion?—They have generally been dead.

14868. Nobody has been spared who evidently had caused the explosion through breach of the rules?—I cannot recollect a case.

14869. You cannot imagine a serious explosion taking place unless it has been through a breach of the present rules?—I can imagine it.

14870. But it is not likely to occur?—No, I have not known of it.

14871. Do you think it is possible by new legislation to further reduce the deaths and accidents list in the mines of this country?—I do not think legislation will do it so much as education.

14872. Quite so; but are there no dangers now which have not been provided for by law?—I do not think so.

14873. So that the work of this Commission is, in your opinion, largely unnecessary?—I think it will largely be so; that is my opinion.

14874. Largely unnecessary?—Yes.

14875. And useless?—Well, I hope it will not be. I should like to see more safety.

14876. But you do not know really any direction in which useful legislation can be passed for the saving of life underground?—Except such as has been suggested already to me. I mean, Sir Lindsay Wood has suggested that we might make the lamp rule a little more stringent. I am not prepared to say that it might not be made more stringent, but still, if it was intelligently carried out as it is at present, I think it would be sufficient.

14877. I suppose that every person who goes underground is supposed to understand all the provisions?—Yes, supposed to.

14878. He is supposed to understand the Mines Act, the General Rules and the Special Rules?—Yes.

14879. Should I be correct in saying that not one person of the rank and file understands them?—I think probably you would; that is to say, in their entirety.

14880. Should I be correct in saying (I do not know whether you would be in a position to give an answer to this question) that 50 per cent. of the general workmen who are not officials of the mine, have never read the rules at all?—I should not be surprised. In fact, I agree with you.

14881. Still, they are expected to read them and to understand them?—They are expected to read them and to understand them.

14882. The Special Rules and the Explosives Orders at the present time are pretty complicated?—I think so.

14883. They are very difficult even for an official to understand?—They are difficult for an official to remember.

14884. And sometimes difficult to understand?—Yes, sometimes difficult to understand.

14885. Do you think it would be more difficult for an ordinary miner who has not had the technical instruction or education which the officials have had, to understand them?—Yes, much more difficult.

14886. They could, in your opinion, be codified and made more simple in some way?—I think so.

14887. I have considerable sympathy with your idea as to education—educating the younger lads who are likely to become future miners as to the dangers by which they are surrounded?—Yes.

14888. You are of opinion that some of the technical instruction in regard to the nature of gases and perhaps coal dust, and other dangers, might be given to the lads at the day-school before they enter the mines at all?—Yes.

14889. If it were put into the Education Act that technical education of that kind, as to the danger and nature of gases and the dangers existing in mines, might be given as a class subject in mining districts, do you think it would be a very useful thing?—I do; it is far better than legislation.

14890. Might I take it that you would agree with me in this: that the miners to some extent should be taken into the confidence of the Home Office and the mine-owners, in regard to the formation of any Special Rules which are necessary for their safety?—Yes, and no. If they will do it with an open mind—a broad mind—yes, most certainly.

14891. You think that if the leaders of the Miners' Associations encouraged the men by speaking to them in their meetings as to the dangers underground, and the necessity of observing certain rules, that would help to educate them?—I do.

14892. In order to secure that, do you not think that those agents should be consulted from time to time on questions as to safety of working underground and the drafting of Special Rules for the prevention of accidents?—My experience is that they are.

14893. In some districts they are taken into account, and with good results, I daresay?—I should think so.

14894. They would be more likely to assist in having the rules carried out if they had really some voice in regard to the framing of them, and if they believed that they were of some service in that direction?—Yes.

Digitized by Google

TWENTY-THIRD DAY.

Thursday, 7th March, 1907.

PRESENT:

LORD MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
H. H. S. CUNYNGHAME, Esq., C.B.
WM. ABRAHAM, Esq., M.P. (Rhondda).
ENOCH EDWARDS, Esq., M.P.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. CHARLES PILKINGTON, called and examined.

Mr. C. Pilkington.
7 Mar. 1907.

The Witness handed in the following Statement:—

14894A. (1) In dry and dusty mines the best way of preventing the accumulation of inflammable dust will be to make the bodies of the pit wagons of steel or iron. I think it will be found impossible to cover the pit wagons in an effectual way, and I believe that the greatest part of the dust in the main haulage roads is caused by small coal falling through the holes and cracks in the wooden wagons rather than by particles being blown out of them.

Spraying journeys is open to many objections:—

First: The water, unless used in very large quantities, would not penetrate far down in wagons filled with small coal.

Second: The water would also quickly corrode the iron and steel wagons, and the holes so caused would allow the slack to drop on to the roads. The amount of water wasted during the operation would be a great nuisance and, by causing the floor to lift, dangerous in places where men are constantly working.

If possible, screening and sorting stages should be placed at some distance from the downcast shaft, so as to avoid the dust from the screens being carried into the mine. I believe that where this is not possible, much might be done in collecting dust from the screens by means of a fan. We tried this some years ago, but were only partially successful, the difficulty being in settling the dust, but I think improvements could be, and indeed have been, made in this matter.

(2) (i.) Complete watering by means of hose pipes in the main roads of coal mines with hard roof and floor might be carried out with no ill effects to the miners and little harm to the mine, and if thoroughly done would destroy the dust; but there are very few mines in which these conditions exist, and there will be less in the future when the shallower mines are worked out. The harm resulting from the water would often more than counterbalance the advantage, as it would cause falls of roof, and in hot mines very seriously affect the health and efficiency of the miners, and the deep hot mines are generally more dusty than the others. We have tried sprays, both with and without compressed air, and though very nice in theory, it was found in practice that they were not reliable. If watering is resorted to, the roof and sides must be watered as well as the floor, as the dust settling there is more inflammable than that deposited on the ground. I produce the weights of dusts taken from different places in the main roads of several mines to prove this. The watering would have to be repeated, but at what intervals entirely depends on the quantity of water used and the dryness of the mine.

(ii.) I think that watering zones of certain lengths, would prevent the extension of dust explosions, but what the length of the zones should be it is difficult to say until actual experiments have been made, as there is so much difference of opinion on this question. I think it would be better if these zones were arched, and paved, and that an arched and paved zone kept properly clean might be sufficient to arrest an explosion without excessive watering. I am strongly of opinion that exhaustive practical experiments should be made as to the length and character of zones necessary to stop an explosion. These zones would in many cases be expensive to create and very difficult to maintain in efficient order, but if mine-owners were only thoroughly satisfied such zones would arrest an explosion there is no doubt they would be erected.

(3) As to the cost of watering completely, it would be very expensive both in capital outlay and maintenance, but the watering of zones would be comparatively speaking cheap, as they would be in the main roads and not in the far workings. £200 a mile would provide and fix 2 in. wrought iron tubing with connections.

(4) My objections to complete watering are:—

That in many cases it would cause the floor to lift and render the roof exceedingly tender, and as more deaths are caused by falls of roofs than by explosions we must take care that in providing against one danger we do not greatly aggravate another.

I also think that in all the deep hot mines of the future, general watering would render the atmosphere so humid that it would be almost impossible to work effectively, and very bad for the health of the collier; this is quite apart from any question of ankylostomiasis, the danger of which is always present when the temperature runs from 70 to 80 degrees in a damp atmosphere.

(5) In any arched and paved zones, if the dust is removed by sweeping, care should be taken that it is collected and this cleaning should therefore be done under damp conditions.

I think the suggestion, that something in the way of a vacuum cleaner might be devised, by which a fan wil deposit the dust into a wet tank, is worth experimenting with in haulage roads.

(6) I have no experience as to salt, but can easily believe that it might be useful, though not when the atmosphere is particularly dry. Salt if used should be applied by means of a spray to the roof.

(7) I think General Rule 12 of the Coal Mines Regulation Act, 1887, and the Explosives in Coal Mines Order, are already very stringent, but would suggest two additions for shot-firing in dry and dusty main roads.

I. (*a*) That only one shot should be fired at a time on such main roads, and that before another shot is fired the place should be examined to see that no fresh dust has been uncovered.

(*b*) That in the case of a blown-out shot on such a main road, a sufficient length of time should elapse before another shot is fired, so as to

Digitized by Google

Mr. C. Pilkington.

7 Mar. 1907.

allow the dust that is sure to have been blown into the atmosphere to completely settle.

II. I also think it might be advisable that one of the under-managers should be present as well as the shot-lighter when firing on main roads.

14895. (*Chairman.*) You are a director of the Clifton and Kersley Coal Company, Limited, of Clifton, near Manchester, a colliery proprietor and mining engineer and late President of the Lancashire and Cheshire Coal Association, and President of the Manchester Geological Society?—Yes.

14896. You first of all deal with the accumulation of inflammable dust, and you tell us that the best way of preventing the accumulation of inflammable dust would be to make the bodies of the pit wagons of steel or iron. We have had some evidence upon that, and there seems to be some difference of opinion as to whether steel or wood or iron is better for preventing the shaking out of the dust. Perhaps you will give us your reasons for preferring steel or iron?—Whenever they are made of wood—all ours, by the way, are made of wood—it is very difficult to get the wood sufficiently seasoned, and the consequence is it dries up after it is put into the wagon, and in almost any wagon you can get a pencil through some crack or other; very often you see spaces of half an inch. It is very difficult to dry an immense amount of timber without warping it.

14897. You are not satisfied with these wooden wagons?—I think we are satisfied in our own mines because our own mines are not especially dusty; but I think if we had to re-stock the pit with wagons completely—the pits, rather—we should in future use iron wagons, at any rate for any new colliery we had to deal with.

14898. As these wooden wagons get worn out, do you propose to replace them by steel or iron wagons?—It would be very difficult to arrange the tare; the tare of the iron wagons would be very different from the others.

14899. You think that would prevent you from using the two together?—Yes, it would lead to a great deal of complication. We should have to gradually get them into groups, and put iron wagons into one pit if we had to do it; but we do not propose to do so in our present pits, which are old.

14900. Because you consider that the mines are not especially dry and dusty?—Yes, and then they are old.

14901. They are coming to an end?—Some of our mines are coming to an end. If we sink in future pits, as we may do, we shall adopt iron wagons or steel wagons.

14902. In the same class of mines you are working?—Yes, the same mines, but a very much greater depth.

14903. Although you are not satisfied with these wooden wagons, and you think if first of all made of steel or iron it would have been better, still at the same time you do not consider that there is any great danger arising from the rather increased accumulation of dust caused by wooden wagons?—No, but we have to be constantly filling up the cracks; we have to be very careful.

14904. Whenever the wood warps you try to make the wagons dustproof as much as you can?—Yes.

14905. It is a difficult job?—Yes.

14906. Then I think that everybody seems to agree that to cover the pit wagons in an effectual way is impossible. I think there has not been any opinion to the contrary. Then you say spraying journeys is open to many objections; first, unless the water is used in very large quantities, it would not penetrate far down in wagons filled with small coal. Supposing the wagons were dustproof, as long as the top of the coal was kept fairly moist, would it matter that the water did not permeate? How would the dust fall on the road?—The wagon would start with a wet top to it, but as soon as it began to get knocked about in the brow, especially if it had a collision, it would throw the coal up, and you would at once bring part of the dusty coal not thoroughly wet up to the top, or at any rate, expose it.

14907. Still, watering a few inches at the top would prevent a great deal of the dust?—A very great deal, but not stop it completely.

14908. But you say that you would object altogether to spraying?—Yes, altogether, because I think in the dry and dusty mines we shall have in the future that iron or steel tubs will be used to prevent the dust, and if you spray them you will very soon rot them, and if you rot them, the dust will fall through just as it does in the wooden wagons.

14909. You have not had any experience as to how far the iron and steel wagons corrode. You do not have iron and steel wagons yourself?—No, I have no personal experience, but I can let you know because I have had the figure given to me of exactly the amount of repairs per box in mines similar to our own.

14910. Where they use iron and steel wagons in many mines spraying is carried out?—Yes.

14911. You say it cannot be carried on except at a considerable loss or, at any rate, with very considerable expense, where you have iron or steel tubs?—Yes, and it is not only the expense there, but when you deteriorate wagons very quickly it means that you will have a good many defective wagons running, however good your precautions are. It is in the nature of things.

14912. In places where they use as you do the wooden wagons, there is hardly the same objection to spraying?—I do not believe it does a very great deal of good, but if we had a tremendous quantity of dust, there would be a real source of danger.

14913. You set one off against the other?—It might be necessary to spray, at least, it might be advisable to spray, but I think other precautions might be better.

14914. Then you say that "the amount of water wasted during the operation would be a great nuisance, and by causing the floor to lift"—I should not have thought that the small amount of water used in spraying, particularly if the spraying did not reach down to the bottom of the coal, would affect the floor?—To get any quantity of water into a dry and dusty slack wagon it would have to be something a good deal more than spraying; it would have to be a good many bucketsful.

14915. The wagons would be sprayed as they were passing, and a good deal of water would not go into the wagons, but fall into the road?—Yes, there would have to be considerable spraying.

14916. You say, if possible screening and sorting stages should be placed at some distance from the downcast shaft. You attach a great deal of importance to preventing the dust going down?—Yes, because the dust from the screens is three or four times more inflammable than any other dust.

14917. More than the dust on the roof and sides of the haulage roads?—Very much more.

14918. What do you go upon in saying that?—I know that it is absolutely pure coal. In the first place I have some figures here, but unfortunately it does not include dust from the screens. We have had dust sent to Professor Dixon, of Manchester, from the screens, or rather, Mr. Bramall had, in the next colliery. He did not tell Professor Dixon where it came from, and he said, "This dust is most desperately inflammable."

14919. That is screen dust?—Yes.

14920. Did the dust come from the same seam as the screen dust?—That I cannot say, but I take it that nearly all coal dusts, pure coal dusts, are very inflammable.

14921. You say that the haulage road dust is not such a pure coal dust, that it gets mixed with other kinds of dusts and does not settle on the sides and roof in the form of pure carbonaceous dust?—In the pony haulage roads the dust is hardly ever at all inflammable, but in haulage roads worked by machinery it is inflammable very often, at least, it is dangerous, but the dust of the roof and the sides, especially of the roof, is far more inflammable than the floor dust, and I believe that it is almost entirely due to the presence of this dust which is so light sticking all over the place that these explosions are carried on.

14922. Still, in your experience the screen dust is more inflammable than any other roof dust on the hauling road?—Yes, that is so, the screen dust collected at the screen itself. You cannot collect it down the pit because you do not know whether it is the screen dust or not.

14923. Then you tried collecting the dust from the screens by means of a fan, but you were only partially successful, and you hope for better results in the future?—If we try again we hope for better results, but it is some years ago that we tried that.

14924. You mean this fan?—Yes, it took the dust from the screen, but we had a difficulty in depositing it. I think inventions have since been made by which it can be deposited rather better.

14925. Do you think that the dust could be prevented by some means from going down the shaft, even if the screens were close to the downcast shaft? You say if possible they should be placed at some distance; you are prepared to think that is the best thing?—I think it is

Digitized by Google

better, and away from the prevailing wind, but you cannot arrange these things; it is very difficult. If you had the chance of arranging it, it would be better to keep them away from the shaft.

14926. Would you say in opening a new pit that it should be made compulsory for the screens to be placed a certain distance away from the shaft?—I should not say that, because I do not see how you could say so. Sometimes you are compelled to put a pit in a certain place, and the screening plant also, but I should say where possible.

14927. Where reasonably possible, you say that it should be done?—Yes. I mean to say it is better where reasonably possible, but not to have the screens right on top of the downcast shaft.

14928. Some witnesses suggested by putting up a partition between the screen and the shaft, or perhaps by carrying the shaft up into the air a certain distance, so that the dust would not go down it, so as to make the opening of the shaft up in the air, that you might in that way prevent the dust from going down?—I daresay you could.

14929. Also if the dust did go down that you could do some good, I suppose, by spraying the inside of the shaft, but then you say that would depend upon the character of the mine whether it would stand watering or not?—It would be very awkward for the hookers on at the bottom; it would be damp and dripping.

14930. It would cause a great deal of damp at the bottom?—Yes, it would be damp and dripping. It is a very uncomfortable place at the bottom of the shaft if it is like that.

14931. You say that there are certain mines in which the watering might be thoroughly done and might destroy the dust. You think there are very few mines in which these conditions exist?—Very few of the deeper mines.

14932. You say that hot mines very seriously affect the health and efficiency of the miners. What have you to go upon as regards the health of the miners? You say that their health would be very much affected by keeping the mines damp. Have you any statistics as regards the miners in dry mines and in comparatively wet mines?—No, I have never had to do with a very deep wet mine, not a mine running to about 80 deg. of temperature constantly, but it must be unhealthy if you have a damp atmosphere. I do not know the difference between working in a damp moist atmosphere. I mean to say a hot damp and a hot dry atmosphere.

14933. On the other hand, it has been put before us that the watering of a deep and dry mine of a very high temperature would reduce the temperature. You would have that at all events to set against the increased difficulty of working in damp heat. The heat would not be so great?—No, because of the evaporation; but I believe the dampness is a greater detriment to work than anything else almost. I think that really an expert ought rather to determine that than ourselves.

14934. You are not very strong upon that point. You would not like to say in what sort of temperature in a damp mine it would be almost impossible to work?—I would never have it in our collieries if I could help it, but I cannot give any evidence that is very strong, because I have no practical experience.

14935. You never had any watering in your own mines which you could avoid?—We had a bit in certain places but our mines are not very hot, they are only 600 yards deep, some of them.

14936. Still, although not hot and only 600 yards deep, you object to watering as being unhealthy, and you do not water more than you can help?—In those mines we do not water more than we can help because we are afraid of the roof and sides. We do know that the roof and sides of our mines are very badly damaged by water, and as we have—well, we have not had explosions, I hope we never shall in these mines, yet we have a considerable number of accidents from falls of roof, and the one danger is very much greater than the other so far as we are concerned; also, all our mines dip 1 in 3½, and when you have anything wrong with the floor or roof of the mine with a dip of 1 in 3½ there is a great tendency to rake over, and the roof is worse to deal with in a steep mine than in another. Our floors I might say are soft clay warrants which in many places swell.

14937. Swell and heave?—Yes.

14938. The reason why you do not water your mines is not that they are so hot that you consider it would be unhealthy, but simply because the nature of the ground is such that there would be more danger from falls of roof and sides; you would lose more life in falls of roof and sides than you would gain by being made less dusty?—Yes, we do water to a certain extent in certain cases, but we do not deluge the mine with water.

14939. With a view to preventing explosions, or because it is pleasanter for the men to work?—We started with the idea of preventing explosions, but since then we have kept it up to make it more pleasant for the men.

14940-1. You have had no explosions I understand; for 40 years did you say?—I do not know; I can speak for 30 years, at any rate—nothing worth speaking of.

14942. I suppose you work these mines mostly with safety lamps?—Never with anything else.

14943. All your mines are safety-lamp mines?—Yes.

14944. Have you gas in the mines?—They are fiery mines.

14945. You are fortunate in not having had any explosions for so many years?—Yes, very lucky. We have gas in the mines and electricity in the mines up to a certain point in the intake just at the bottom within 100 yards of the shaft. After that, nothing but safety lamps.

14946. Then you go on to say in paragraph 2 (ii) that you think watering zones of certain lengths would prevent the extension of dust explosions. You form no opinion apparently as to the length of the zone that would stop an explosion?—No, none that is worth giving as evidence.

14947. You think that an arched or paved zone kept properly clean might be sufficient to arrest an explosion without excessive watering. What do you mean by "excessive watering." Do you mean without watering with danger to the floor?—I mean just spraying it or syringeing it occasionally—just keeping it a little damp.

14948. You think that would be sufficient?—I should say so. Later on in the paragraph I suggest that experiments should be made.

14949. Dust might be removed by sweeping and a vacuum cleaner might be devised?—Might be.

14950. You say that exhaustive practical experiments should be made as to the length and character of zones necessary to stop an explosion?—In carrying out experiments I do not think it is necessary that all experiments should be exactly in the same way. I think some should be tried with the walls of this zone of different shapes.

14951. What do you mean?—If you have an absolutely straight zone a blast would blow through it at a tremendous pace, right away through, and if the sides are smooth it will go so much further than in another kind of zone. I should suggest that bends-back should be put in the side of the zone so that if there was an excessive current through, which there would be in an explosion, some of that would be caught and thrown back against the other.

14952-3. A sort of eddy?—Yes, that can be easily tried in a small zone this size (*indicating*) with small charges of powder. I do not know that my suggestion is worth anything, but it might be tried.

14954. Then you say that zone watering would be comparatively cheap as compared with the cost of watering completely, and at any rate it would not cost more than £200 a mile to provide and fix 2-inch wrought-iron tubing with connections?—That does not, of course, give you the water supply which is different in every pit. I could not give that.

14955. Then there is the cost of working it?—There would be only the repairs.

14956. You would not want any extra labour to work it?—A very small amount.

14957. It would cost £200 a mile, and there would be very little extra expense in working it?—Yes, perhaps one man to see that the pipes were right, but you would want an engine if necessary to put the pressure of water on or bring the water from the top. You want decent water, you do not want nasty water sprayed over the place. I mean you do not want foul, contaminated water, and also in spraying—we tried the sprays before and we found that it was very difficult to keep the small particles out of the spray nozzles, they were constantly being blocked up, and that is the reason why we gave up spraying. I think that watering of the roof, which is the most important of all, because the floor is sure to get some water, ought to be done either with a shoot of water or a syringe, because a great deal of the watering in pits is done by sprinkling the floor, and they leave the most important part untouched very often, or only partially touched.

Digitized by Google

Mr. C. Pilkington.

7 Mar. 1907.

14958. With regard to the practice of sprinkling the floor, it is represented by some witnesses to us that that does a great deal of good, because the dust from the roof and sides is constantly being swept off by the ventilating current and falling to the floor, and if the floor is damp that prevents the dust from rising again and renders it moist and innocuous, so that many people think where it might be difficult to water the roof and sides that if you were to water the floor slightly that would still effect a great deal of good?—Yes, it might.

14959. Are you an authority upon this question of ankylostomiasis which you refer to? Have you had occasion to come across any cases of it?—No, I only heard of one. I am not an authority, only I looked into the subject two or three years ago very carefully.

14960. You consider that the danger of ankylostomiasis is always present when the temperature runs from 70 to 80 deg. in a damp atmosphere?—80 deg., perhaps.

14961-2. Not less than 80 deg. would be sufficient to encourage the germs into life?—I brought it up before at the Mining Association for this reason: all the mines that are now being opened up, or a good many of them, are of considerable depth, about 1,000 yards. That ensures a temperature in the far workings of at any rate 80 deg., and the mines of the future are much more liable to ankylostomiasis than the present ones are, at least, that is what I gather from looking into the subject. I believe you have got much later information than anything I know of about ankylostomiasis.

14963. Then you say in any arched and paved zones if the dust is removed by sweeping, care should be taken that it is clean, and this cleaning should therefore be done under damp conditions. Some witnesses have told us that it is not necessary to damp the dust; that they collect it dry and put it into tubs or barrels and just take it up as it is?—I fancy that a good deal goes forward.

14964. Then with regard to salt, you say you have no experience of that?—No.

14965. You say if the atmosphere is very dry the salt would not have any effect or a very slight effect?—Yes.

14966. You must have a fairly damp atmosphere to have any effect?—Yes.

14967. Probably sprinkling of salt would diminish the danger to the life of the miners in a very wet mine?—Yes, I should think so.

14968. If you found it necessary for any reason to have a mine in a very humid condition it might be desirable perhaps to salt it, not with a view to doing away with dust or preventing explosions, but simply for the dry atmosphere it might be a good thing?—I do not know how much salt you would require for that purpose. I have not looked into that question.

14969. Then you suggest certain additions for shot-firing in dry and dusty main roads, first, that only one shot should be fired at a time on such main roads, and that before another shot is fired the place should be examined to see that no further dust has been uncovered. Is that in any of these Special Rules?

(*Mr. Ratcliffe Ellis.*) I do not think that it is provided expressly in the Special Rules. There is a provision that there should be an examination made, but it does not say that you may not fire more shots than one at a time.

14970. (*Chairman.*) You think this might be made a General Rule to apply all over the country?—Only in dry and dusty mines that are dangerous, because I feel sure that if a place is watered in the ordinary way that one shot may easily uncover enough dust to make it dangerous again: it ought to be examined after each shot in a dry and dusty place. I am speaking now of that entirely.

14971. That is the Act of Parliament now: you water if you fire a shot in a dry and dusty place. You would say wherever watering was required by the Act of Parliament in that case only one shot should be fired at a time?—That is so.

14972. Would you suggest that that might be made a General Rule and apply all over the country and be put in the Act of Parliament or Explosive Order?—I say that there would be no harm in it; it tends towards safety. I think it is a reasonable thing. We shall insist upon it in our mines in future.

14973. Then, secondly, that in the case of a blown-out shot on such a main road a sufficient length of time shall elapse before another shot is fired. How is that?

(*Mr. Ratcliffe Ellis.*) The only thing about that is this: before a shot is fired there must be an examination made of the surrounding places to see that it is clear from gas. Whether it would be implied from that that there must be a sufficient time to make that examination——

(*Chairman.*) This is not to make an examination, but to allow the dust that is sure to have been blown into the atmosphere to completely settle. That is the point.

(*Mr. Ratcliffe Ellis.*) I understand the suggestion is that the same precaution should be taken against dust as is at present taken against gas.

(*Witness.*) If you have ever seen men after a blown-out shot they are all covered with dust for a great distance. It raises a great quantity of dust for a long way down the road. It might be clear where the shot is, but the dust which has been blown further on might easily come back. The air might be more or less full of particles that you can hardly see.

14974. (*Chairman.*) The air current might bring back a lot of dust?—Yes.

14975. You think it would be a reasonable thing to make some General Rule of this kind that wherever a blown-out shot occurs, the dust should be allowed to completely settle before another shot is fired. There are so few blown-out shots now, only one perhaps in 1,000 or more, that this Rule would not at all bother the mine-owners?—No.

14976. (*Dr. Haldane.*) I should like to ask if that applies also to blown-out shots in roads. I mean what you have just said now?—I was speaking of dry and dusty roads.

14977. It is there that the dust is produced by a blown-out shot?—Yes.

14978. (*Chairman.*) If you have a blown-out shot in the face what would you do with it?—We do not fire shots in the face, but I would give any blown-out shot plenty of time wherever it is.

14979. You think that this rule should apply to any blown-out shot in the face in the main road or anywhere else?—There are so few of them it is a very reasonable thing.

14980. It is a small matter?—Yes.

14981. To the mine-owners or managers, and at the same time you think it might prevent a considerable accident?—Yes.

14982. You also suggest that one of the under-managers should be present as well as the shot-firer when firing on main roads. I suppose you would suggest, as has often been suggested to us before, that each particular shot should be authorised by the manager or under-manager?—That is so now.

14983-4. That is not in the Act of Parliament?—But it is in the Lancashire Rules.

14985. (*Chairman.*) You go further than that, and think that the under-managers should be present or one of the under-managers?—Yes, one of the under-managers, not the certificated manager.

14986. Not the manager who gives the order to fire the shot, but some under-manager under his direction?—Above the shot-firer.

14987. That would apply to the ordinary shot-firer?—No.

14988. Somebody above the ordinary shot-firer?—Yes, in dry and dusty main roads and places that you consider as dry and dusty and dangerous.

14989. (*Mr. Cunynghame.*) Your remedy apparently comes back to zone watering, provided that after a thorough series of experiments zone watering can be proved to be an effective mode of isolating an explosion?—Yes, I should think so.

14990. It would not be unfair or cause a difficulty to the trade generally to make a requirement to that effect. I suppose in addition to that opinion you cannot mention any circumstances which would make it too great a hardship?—It would not make it a hardship in our mines unless the watering is excessive, and unless the watering is proved to be detrimental to the health of the collier and the tenderness of the roof of the mine.

14991. I am speaking, of course, of zone watering only?—If you keep a zone constantly wet and the air is always going through that zone, if it is exceedingly wet and there is constant spraying going on, the atmosphere that comes out of that must be very considerably damper than the atmosphere entering the zone.

14992. Do we not know sufficient of the effect of partial watering upon the moisture produced thereby in the air to be able to know beforehand, now at the present time, whether that would do harm or not? I mean it would

Digitized by Google

be a very difficult thing to pause to recommend the zone watering until you know about the health of the miners, which is a matter that could not be determined except by the experience of many years. Do you not think that we must risk the question of the health of the miners in this sense, that it is not sufficiently proved that the watering of zones would do them harm to make one pause in recommending zone watering ?—No.

14993. Assuming that zone watering would be effective ?—That is what I wanted to say. A great deal more would be done by colliery proprietors in this matter if they knew that they were acting on right lines and were not going to spend a good deal of money on something which is of no use.

14994. I suppose through the country, if zone watering was brought in, the expense, if you count it all up, would be very considerable on the trade as a whole ?—Wherever the mine has got a bad floor and a bad roof it would be very considerable to keep the zone in good order, and the very fact of watering the zone makes it worse to keep.

14995. The initial expense would be considerable of putting in pipes ?—Yes, I do not think we should object to the initial expense.

14996. Before entering into that initial expense it would be very satisfactory to have some experiments made ?—Very.

14997. Even if these experiments cost, I will put a mere hypothetical figure, such a sum as £10,000, that money would be very wisely expended ?—Very wisely, I should think.

14998. It would be a trifle in comparison with the money wasted without such experiments ?—A very small trifle, but I think one of the main things is something you can hardly prove, and that is, how difficult they are to keep up, I mean to keep these zones up after they are once established. You can only prove that the zone is good; you cannot tell how much trouble there will be in keeping it in order.

14999. Still, a good deal is known of wet mines and of mines that are partially watered, and you could perhaps prove by experiment that an isolating zone of 100 yards or 50 yards or whatever it may be, effectually kept up, would be sufficient to stop an explosion ?—Of course that would be satisfactory, but I think quite as much good, or even more good, than the watering of zones, is done by keeping the dust as much as possible from going down the pit, and by exercising care in shot-firing. I should be very much relieved, personally, if I knew that zones were effective; but still, I think the other points mentioned, trying to keep down the dust and the shot-firing, are even more important.

15000-1. Would you suggest that as compulsory—I mean about keeping the wagons in the mines of such a character that they could not let the dust out. That is a very big order, and one must think of that in this case ?—It is a very big order and that could only be done in new collieries. It would stop the colliery almost to provide the thousands and thousands of pit tubs if they should suddenly be changed and made of iron. Of course, you could not do that; that would be too great a change.

15002. At all events, in addition to or as a substitute for zone watering, and especially in the case of new collieries, you are advocating effectively closed wagons ?—Yes.

15003. (*Mr. Ratcliffe Ellis.*) You are quite alive to the danger arising from coal dust ?—Yes.

15004. Speaking for yourself, and I think other colliery proprietors, if any practical method is devised of rendering that danger less, coal owners are very glad to adopt it ?—Certainly.

15005. Have you had any analyses of the different kinds of dust ?—Yes.

15006. Would you tell the Commission with what result ?—Unfortunately, I was away in Scotland, and these analyses had to be hurried in collection. I had the dust taken from different places. I could not go into the chemical compounds and all that, or have an analysis made properly. I thought the best way would be to weigh equal quantities of these dusts, because the lighter dust is naturally more dangerous. These dusts are taken from all kinds of places, the main roads, the haulage roads and the returns, and taken in each case from the sides and the roof and the floor, and there are different weights of all the dust here; you might like to glance at them. With these dusts we carried out this rough experiment which Professor Dixon of Manchester suggested to us; that is to say, that we should fill a glass; we filled a long glass tube with about one-thirteenth, I think it was, of gas, and the rest air. Then we took each of these dusts in a sort of pepper-pot—a sprinkler—and removed the top from that and put the flame over and sprinkled the dust on. This is rough, of course, but if the sparks from that flame tumbled down to the bottom of this tumbler we considered it rather explosive. I do not suppose that it was really very explosive dust, but still we put it down as explosive. If there was a very slight flame of dust at all, we put it down as slightly explosive, and we carried out that experiment with a good many dusts here, which you can have.

15007. What is the result ?—The result is in all these experiments—it is always roof dust—there is only one case where a floor dust is even slightly explosive, and that is put down as explosive. I do not understand that at all, but it was in an airway in a small mine. It was not travelled, and the air came from one part of the mine to another through this place. It may have happened a lot of dust settled there which we did not expect. At any rate, that is the only case where there was anything wrong with the floor dusts, but the roof dusts are constantly wrong.

15008. Those are explosive ? (*Table handed in by the Witness*)—Shall I explain that to you ?

15009. (*Dr. Haldane.*) I do not quite understand the nature of these experiments ?—It is very rough.

15010. (*Mr. Cunynghame.*) I did not understand how the flame was put ?—(*indicating.*) That was full of air in the ordinary way, and it was filled up with gas—one-thirteenth.

15011. (*Dr. Haldane.*) Was it inverted ?—Yes, that was inverted. Then you put one-thirteenth of gas and twelve-thirteenths of air.

15012. (*Mr. Cunynghame.*) Just a proportion to make it a licking flame ?—Yes.

15013. (*Dr. Haldane.*) It would explode fairly well with that ?—We were told to get it so that it would not explode, and we found that one-thirteenth of this gas did it. That was inverted, and there was a cover kept on it, and you put the flame of the taper to it like that and peppered dust over it. It was a rough experiment, but still it did show difference between the dusts.

15014. (*Mr. Cunynghame.*) When the dust was explosive, what was the difference. What effect did you see ? You say in any case the gas ignited ?—No, but the dust ignited and fell down in nearly all cases—burned, practically speaking, everything that went through the flame, burned and went to the bottom, and the other dust did not; all this pure dust was burned before it reached the bottom of the glass; all that touched the flame was entirely consumed and went down in a red stream.

15015. What part did the gas play in it; it may be done without the gas ?—No, it would only show little sparks in the air.

15016. You wanted the gas to burn up ?—You wanted this more or less to supply a gas to help the flame. At any rate, that was suggested as a rough test. It is not a good test; it is not a scientific test or anything of that sort, but the result does show you——

15017. That the roof dust was much more dangerous ?—Yes.

15018. (*Dr. Haldane.*) Would not that depend upon the fineness of the dust, whether the particles were burned up ?—Yes, in an explosion it is the very fine particles.

15019. It sounds as if it were more of a test of the fineness of the dust than anything else ?—All the dust we wanted we sieved through the safety lamp gauze to begin with. If you take the dust of a roadway it is all full of grains; it is very coarse stuff. For that experiment everything had to go through a sieve of some size to get at the same fineness, more or less.

15020. A lamp gauze is rather coarse ?—Yes, it only eliminates the coarse. That is the test all round, such as it was. I thought the most important thing was the weights of these various dusts.

15021. The weight for a given volume ?—The weight for a given volume very carefully scraped off the top. The result of this very rough experiment is given here. You will see "slightly explosive," and so on, and there is one that is explosive. Then comes the ventilating current, and whether intake or return, or what, and that shows the whole history of the place.

15022. The floor dust is about twice as heavy as the

Digitized by Google

Mr. C. Pilkington.

7 Mar. 1907.

other; what is the reason of that? Is it due to the admixture of stone or simply to the coarser character?—Partly; in many of the haulage roads and travelling roads it is due to the stone, but a great deal of the roof dust is so fine——

15023. (*Mr. Cunynghame.*) The specific gravity of a given volume of the dust is, to a certain extent, a measure of its explosive quality?—Yes; that is why I give the weights. The measure was taken in this way: it was with dust like that, carefully scraped off with a scale so as not to press it at all.

15024. (*Mr. Ratcliffe Ellis.*) There is no objection to its being handed in?—No; it is not scientific, but still it is rough and practical.

15025. Have you a screen dust?—No.

15026. (*Chairman.*) Did you find screen dust by your test?—No; I could try it and send it.

15027. What makes you say that it is more explosive if you have not tried it?—It was tried at the neighbouring colliery by Mr. Bramall.

15028. (*Mr. Ratcliffe Ellis.*) Are there some mines in which watering would be impracticable and the strata would be brought down altogether if they were watered?—Yes, I think that in some of the mines with very soft clay floor it is almost impossible to water to any great extent.

15029. Have you formed any opinion as to whether in an ordinary road which is not prepared you could clear away so much dust that what was left would not be injurious?—I think a great deal might be done, but I think in that case you would have to have a jet of compressed air to blow the dust out of the crannies. With a jet of compressed air I think you might arrange that any ordinary road might be kept clear, and the fact of there being props would have a tendency to prevent a blast going through it very hard, better than a thing like a gun barrel which you can shoot right through.

15030. If clearing of the dust could be made efficacious that could be done in every mine, and watering only in some mines?—To make it properly good instead of timber you would have to have iron or steel girders.

15031. There would have to be some special preparation?—Some special girders which you could easily clean instead of wood props, the bark of which holds the dust so much.

15032. Do you think a zone could be so far prepared that all the dust could be cleaned by means of special girders and special preparations, or would it be necessary to have an archway with smooth sides all round in order to keep it clean?—An archway would be much easier to keep clean. There is no doubt about that. But it would be like a cannon. If you want an explosion to go through a cannon the smoother it is the better.

15033. With reference to archways there might be a difficulty in keeping those up if the mines are very deep?—Yes, the only thing is you have to have archways in deep mines. You can keep them up at very great expense; if absolutely necessary there is no doubt that they can be kept up, but they would be very expensive.

15034. Do you think reasonable protection can be given as against the danger of dust either by watering zones or by dust clean zones, or if neither one nor the other was reasonably practicable, some regulation with reference to shot-firing, either that the shots should only be fired between shifts or some regulations in excess of those now in existence?—I think our regulations in Lancashire are very stringent as it is now, and with these two recommendations I make I think as far as you can humanly make shot-firing safe, you would do so. I do not think that you can go much further, and those two recommendations are comparatively easy to carry out.

15035. Would you not think it right that these alternatives should be left to the managers?—Yes.

15036. In one way or another he must render the danger from dust as small as possible?—Yes.

15037. You would leave him to decide that according to the circumstances of the mine?—Yes, because one course might be possible in one case and not in another. It is no use trying for an absolutely perfect thing; if you cannot keep it in order you are relying upon something which may be a snare.

15038. (*Mr. Wm. Abraham.*) Have you had any experience in spraying the trams as they go along?—No.

15039. How deep do you think it would be possible to wet the surface of a tram in order to prevent the dust rising?—It depends on circumstances. Our mines are very steep and when they come to the bottom they come to the bottom with a good bang like this (*indicating*) which throws up the side of the coal at the near end pretty considerably, and the back end goes almost like that (*indicating*). I think you ought to have about one inch of it damp where you are going to knock the tubs about very much.

15040. Does all your coal come down a steep like that?—Very nearly all of it either comes up or down—every bit of it.

15041. How is your main road?—Our main road is on the level.

15042. The spraying of the water would be done on the main road chiefly, would it not?—The main jig brows that bring the coal from above are of much greater length than many of our main roads. They run to 1,000 yards or 600 yards. They are not our main roads, we call them jig roads, but still they are main roads, and they are all on the dip, 1 in 3½.

15043. Most of your main roads are not on the level?—No, half on the level and half in that way. There would be the coal field (*indicating*), and that is the dip. All *these* roads are on the dip, 1 in 3½, and all *these* on the level.

15044. Did you give the Commission to understand that your main roads were on the dip like that when you were speaking of them here?—No, I think you are right there. When I was speaking of the main roads I had in my mind the level roads.

15045. You think that in any case watering penetrating to the thickness of one inch would prevent the dust rising?—It would prevent a good deal of the dust rising. I should think so, but I cannot say to what extent. Any watering must prevent it to a certain extent.

15046. Any watering?—Yes, it would prevent some.

15047. A continual spray would prevent it all?—What do you call "a continual spray"?

15048. On your main road?—For what length?

15049. The whole length?—Yes, but you do not propose to spray along the whole length.

15050. Supposing you sprayed twice during the journey, would that lay the dust sufficiently?—I should think it would have a great tendency to prevent it; of course, if you could have constant sprays all along, you would be bound to stop the dust.

15051. Where they have sprays to a considerable distance your objection is met?—That objection.

15052. Would spray water penetrating the surface of a tram one inch, have any great effect upon the corrosion of the tram?—Yes.

15053-4. How?—It would percolate to the bottom of all the tubs filled with round coal.

15055. I thought you were speaking here of trams of small coal?—Trams of small coal and round coal are all mixed together.

15056. Then the water on the surface percolating through the round coal would be affecting the coal and not the iron?—It would get to the iron bottom. I am very anxious that where iron is used you should not have a wagon that will leak coal dust through, because I feel sure that a great amount of dust is caused by the leakage of dust through the wagons.

15057. So that making the bottom tight with wood would preserve the wood rather than damage it?—What about the wagons that were dry.

15058. It is not a question of providing for that which is dry. We are trying to provide for damping the dry dust and prevent it blowing into the air.—You could not keep wagons with wood bottoms constantly wet without using such an amount of water that it would be utterly ruinous.

15059. That is exactly my point, that the amount of water penetrating one inch of the surface would not go to the bottom?—No.

15060. If it would not go to the bottom where it is wood, it would not go to the bottom where it is iron?—You cannot spray one wagon in a train in one way and another wagon in another way. If one wagon keeps the water at the top because filled with slack and the next is filled with lumps this size, the water has a different effect on each wagon.

15061. The great bulk of the water would affect the coal and not the tram?—It would not if you put enough

Digitized by Google

spray on to a wagon filled with dust; you would get a certain distance, but if you put that amount of water on a wagon filled with clean round coal, that water would nearly all go to the bottom.

15062. I think we have agreed that sufficient water to damp one inch of surface of a tram is sufficient to lay the dust as well?—For a time.

15063. The dust rising is much more from one than the other?—Yes.

15064. Have you experienced a road lifting from the effect of artificial watering?—I have not personally seen it, but I know that our managers say it does so. I have seen whenever there is a leak in any of our water-pipes from the pumps, that there comes a fall of roof and a lift of the floor.

15065. There would be a continual dripping from the leakage. "*Dyfal donc a dor y garreg.*" That means that constant dripping will break a stone. That is a Welsh adage?—That Welsh proverb is perfectly right. The leak we have in the pipes is very soon stopped, but the other one is the constant dripping of your Welsh proverb.

15066. Has anybody seen roads rising from artificial watering?—I know it is so. I will tell you what I have seen; I have seen the roof coming down in small bits.

15067. We were on the bottom; now we are coming to the roof. How many inches would you have of dust on the road to consider it a dusty road?—Well, there is dust and dust; sometimes that dust is very heavy sort of stuff on a travelling road; it is not a dangerous dust, but is objectionable for men to walk in. I think when you have about one inch of fine dust lying about all over the place that I should call it a dusty road; but if it is pretty clear in the middle and one inch or so at the sides I should not call it a dusty road. I could show you what I call a dusty road, if you would come down the pit. It is difficult to answer that question. I could show you what I call a dusty road, but I have not measured the actual thickness of the dust. I have not taken a footrule and measured it.

15068. When you are speaking of watering being the cause of heaving of the road, you were then thinking of a considerable watering?—Yes.

15069. That would not happen with a simple spray?—If it was a small amount of water—just damping the dust—I do not think there would be a very great effect on the floor, but it would touch the roof a little bit.

15070. We will start with enough watering to lay the dust; that would not affect your roadway?—You must not take that as an answer in that way. When you say you will have a certain amount of water put on a road to ensure the dust being laid, sometimes there would be too little water and sometimes there would be too much water. It is very difficult to control.

15071. In the case of too little water, that would not touch the surface of your road at all?—No.

15072. Then there would be no danger of the road heaving at that point?—It would not heave to a very great extent.

15073. If the water does not touch the surface of your soft road, then it would have no effect; it must be one or the other?—If you put water anywhere it causes a humid atmosphere.

15074. Would the dust absorb the water?—Not completely; not all over the place. It is not exactly the same thickness all through.

15075. Quite?—I would advocate watering wherever it would do no damage, but I am afraid of going from one thing to the other.

15076. The question is whether it does damage. I have not found out yet to-day where artificial watering does damage. That is what we are dealing with. We know the effect of natural watering. I cannot see that an amount of water which is simply sufficient to lay the dust will cause the heaving of the road. I have not seen that yet?—Have you ever noticed the difference in a roadway after a very dry spell of weather and sudden moist, warm weather? You must know the difference between the roof——

15077. Yes?—When you are going down you see little bits of metal from the roof all over the place. That proves how the humidity in the atmosphere is bringing the roof down.

15078. That is quite true, but that does not yet affect the cost nor anything else. That kind of dampness affects the health. Health is everything?—Yes.

15079. That is my point also.—Health is everything, there is no doubt.

15080. When you speak of affecting the health of the men, what men do you mean? Do you mean the men who are working on the roads, or the men who are working in the faces?—It is the men working at the faces, the men working after the air has passed this damp zone, because the humid atmosphere of a damp warm day, which I was speaking of, would bring down pieces of dirt in the mine at very considerable distances, which proves that the humidity of the atmosphere is not taken up by the dryness of the mine. It still takes a certain amount of water with it, and that dampness would reach the far end.

15081. I agree with you; a certain amount. Have you experienced in any of the collieries you are connected with watering of the main road affecting the men in the faces?—No, I cannot say that I have.

15082. That is all I ask you.—But then as I say, we have given up artificial watering except just to damp the roads a little bit for the sake of the men travelling them.

15083. The less the effect on the men then?—Yes, we do not want to put too much dampness on the top of the men for one thing.

15084. (*Dr. Haldane.*) With regard to the effects on the health of the men of watering, I suppose you have considered that watering of the main road at any rate reduces the temperature very considerably, as well as increases the moisture?—I know it must.

15085. It does as a matter of experience?—Yes, I know it does.

15086. So that you gain in that way although you lose in adding moisture.—Yes, that must be so.

15087. I believe actually the wet bulb temperature falls beyond the watered place?—Yes, I am sure it must do. In fact I have heard that it has been measured.

15088. In that way, if the watering is judiciously done, one need not fear the effects of the moisture in the air on the men?—Not so much. I think one thing counterbalances the other to a certain extent, but I do not quite know to what extent, and I know that our men do not like working in it; they like working where it is dry. A good deal is the comfort of the men themselves as well as their safety too; I mean you have to look at both. I quite admit that very likely one counter-balances the other. That could be proved scientifically.

15089. You said you have a steep incline?—One in three and a half.

15090. It has been put to us by another witness that the inclination of the seams in Westphalia makes it easier to completely water the mines, and that the flat seams in England are as a general rule much more difficult to water. I mean difficult as regards the roof giving way. Have you ever gone through any of the mines in Westphalia which are completely watered?—No, I have not.

15091. There the main roads are not in the coal seam at all they are cross cuts. One can understand the watering doing less damage there, but in the seams themselves the watering is carried on and apparently there is not very much damage?—Of course the damage would depend on the quality of your floor. It is these soft fireclay floors that are so troublesome with us. The prop sinks in.

15092. I wanted to ask you with regard to the zones, how far from the face do you think it would be desirable to maintain a zone either watered or arched?—I think that the farther from the face the easier to maintain. ✓

15093. The easier it is?—The farther from the face it is easier, but the farther from the pit shaft the more effective. ✓

15094. There would be great practical difficulties in maintaining say an arched zone anywhere near the face, would there not, on account of the roads not having settled?—I think even if it was some slight expense extra that it would be better to have the zones as far from the pit shaft as you can effectively keep them.

15095. I quite agree, and I wanted to ask you if you had ever considered roughly how near the face you could get zones of that sort to stand?—Every mine is in a different position. It would entirely depend upon how you took your air. It is so very difficult to give an opinion unless you have a plan.

15096. I was thinking of a longwall face?—I should have it as near as possible where all the roads split off, keeping it as close as possible. If the mine is divided into three districts, one up brow, and one level, and one level there (*indicating*) I would have the zones as far as

Digitized by Google

Mr. C. Pilkington.

7 Mar. 1907.

possible so that *that* zone should command the whole of that intake, and *that* zone should command the whole of that intake.

15097. Do you think it would not be also desirable to have a zone at the pit bottom in the shaft pillar of some sort?—Yes, but I should have it away from the pit if possible, I think. If you let an explosion get too big a head it will come through any zone. I do not think 200 yards will stop an explosion when it is going, whereas 50 yards will probably stop a small one.

15098. Supposing you have an explosion started on a main haulage road, and there are only zones near the face, the explosion will sweep the whole of the haulage roads in that pit or be liable to do so?—Yes.

15099. For that reason would it not be advisable to have some sort of protection near the shaft?—Yes, after all a vast quantity of the men are either at the face or where the drawers land their boxes, in our case to jigs where they bring them down the main road. There the men are, and if you can safeguard that lot of men against anything *here* or *here* (*indicating*), and that lot (*indicating*) you have done a great deal.

15100. Supposing you have an explosion which sweeps the main roads of the mine and is stopped by zones near the face, you have these roads destroyed more or less, and filled with afterdamp, which will be carried forward upon the men by the ventilation so far as it still exists?—We never fire when the men are in those roads and the men are in the mine.

15101. Supposing you have only zones further up do not you think it would be very desirable to take every possible precaution against an explosion on a main road during a shift?—Yes.

15102. Would that not point to preventing shot-firing except between shifts?—I think in dry and dusty mines——

15103. In dry and dusty mines, of course?—In dry and dusty main roads I think so.

15104. That is almost the only possible source of an explosion?—Yes.

15105. Shot-firing in a main road?—Yes, it is very seldom that you find a defective safety lamp now.

15106. Even a defective safety lamp would not cause an explosion on a main road?—No.

15107. There would be never practically any gas there?—No. I think you would have to see the position of the zones. There is the return airway to deal with in all these cases; it is a difficult problem.

15108. Except in Wales an explosion never affects the returns—I mean a coal dust explosion?—I have seen one that has, the only one that I have had to deal with.

15109. Where was that?—The Wood Pit explosion in Haydock where they lost 198 men.

15110. Was that a dust explosion which traversed the returns?—It became a dust explosion, I suppose, although in those days we did not think much of dust. It originated in an outburst of gas, we know, because I saw the crack where the gas came out and fired at once, and that was four weeks afterwards. I could not get up to this place, it took three weeks to clear it of gas and after-damp, and it was still coming out in large volumes then.

15111. That might have been a gas explosion which would naturally affect the returns?—Yes, it was an explosion at the face.

15112. Starting at the face?—Yes, there was no disturbance there. I was the first into that place, so that they were just as they were, and we know that was an explosion at the face of coal. That certainly came down both intake and return roads; in fact it did rather more damage in the return there. It was swept completely clear of timber.

15113. The return was not used for haulage?—No, only just one part of it. Nearly all would be dusty; it was dusty, I know.

15114. Still, it is exceptional to have a dusty return?—Dust comes in sometimes. Some of our returns are dusty.

15115. I notice in this analysis that the dust from the roof in various main returns had a specific gravity of about double the dust on the roof in the intakes. I think there is one exception, namely, the Cannel Seam?—Yes.

15116. In the Cannel Seam there was light dust in the returns, but in the other cases there was either no dust at all or very heavy dust on the roofs?—Yes, there is a good deal of dust which gets disturbed in the workings and goes along the returns, and the other is mostly dust that tumbles through the crevices in the wagons in the intakes.

15117. This dust in the returns, according to this analysis looks as if it were not very explosive if the lightness is a measure of its explosive powers?—I should think it was not.

15118. It looks as if it was partly stone dust?—Yes, that is what I say; I think a good deal in the returns is stone dust caused from the workings. What stone dust is carried in the returns is exceedingly fine dust and reaches a long distance; exceedingly fine dust will get in the returns.

15119. Coal dust?—The stone dust would be exceedingly fine.

15120. The stone dust is of no importance?—Of no importance at all. I had an analysis of one of the returns. I was down the mine with Professor Dixon and he said: "This is a nasty, dangerous place." I said: "Take a sample," and he did, and he said after that it was not at all explosive.

15121. From a return?—Yes, and it was mixed with that very fine stone dust so much that it counteracted the coal dust.

15122. I think it is very evident from the records of explosions, at any rate in the North and Midlands of England, that a return airway is very seldom affected, that is by a dust explosion?—Yes.

15123. (*Mr. Enoch Edwards.*) I gather from the figures you quoted to Dr. Haldane that the dust of most of the main roads was much heavier than the dust found on the timbers?—On the floors, very much.

15124. We should rather expect that, should we not?—Yes.

15125. It is rather an indication that is why it has got up there?—Yes.

15126. I understood you to say that this Wood Pit disaster was the only one with which you were familiar?—That is the only explosion which I was concerned with all through.

15127. You have had the good fortune to escape them at collieries where you have managed?—Yes.

15128. You yourself have had no experience of the state of a mine before an explosion and after?—I have had one experience. I do not think that many people have a great many—I hope not—before and after.

15129. There are people who have been here and made suggestions that dry zones, dustless zones, have effectually prevented the spread of an explosion?—Dry zones?

15130. Yes. The point is to get to know whether they knew of their own knowledge the state of the mine before the explosion and the state of the mine after the explosion?—Yes, quite so.

15131. I understand you to suggest that there are seams where it would not be possible, the risk would be too great, to water mines effectively?—I think there would be a great deal of damage to the mine, and it would lead to roof accidents.

15132. Have you proof of that in your own experience of your place?—I know that wherever we have any watering in the mine of any sort the floor begins to lift; not in all the mines, but in some of them.

15133. In your own collieries?—Yes, we have two or three seams of almost fireclay underneath, very good warrant indeed, about one foot thick, and another two feet thick, and it is very liable to lift. It is absorbent; the least exposure to damp causes it to be humid, and it soaks it up like a sponge.

15134. You have not attempted the suggestion made to create zones in your pit?—Yes, but we do not keep them up. We collect dust on the main roads, and try to stop the dust on the main roads; but we have given up the sprays which created the damp zones.

15135. I understood you to suggest in your colliery that you had a long length of jigs?—Yes a great many jigs; all the coal practically speaking comes down.

15136. It is sharply graded?—Yes.

15137. To the main level you fetch them, 600 yards to 800 yards?—That is the extreme; not all in one jig.

15138. I suppose you have some distance of heads or levels above that?—Yes, that is the extreme.

15139. I was taking the figure you gave?—That included everything. The longest main jig is 600 or 700 yards.

15140. It is not an excessive gradient?—1 in 3½.

Digitized by Google

15141. You know a good deal of mines with a much sharper gradient than that ?—Yes.

15142. In those cases where would you place your zones —in the bottom lower level or in this long length of jigs 600 to 1,000 yards ?—I think I should put it in the lower level, because it is easier to get water there for one thing. You can more easily maintain it there at the bottom of the jig in the main level, and then it is easier to deal with any repair in the level than on the jig.

15143. Are those jigs timbered roads ?—Yes, mostly.

15144. In this long length of jigging I suppose you have a great deal of dust ?—A fair amount gets out of these wooden tubs.

15145. Is it not likely that you would have more dust in the jigs than in the main haulage roads ?—Yes, quite as much at any rate.

15146. How do you treat those now ?—We treat those by cleaning them up dry. I think it was suggested before that I had used the words "main levels"; I really meant to include the main jigs, too. It was a slip of mine.

15147. According to your experience, if you have a dry mine and a sharp gradient in jigging, you will have a considerable amount of dust in the jigs ?—By the time the box has got lower down it has generally lost its dust. The first knocking about will knock the dust out.

15148. In speaking of tubs, can you give us any idea what is the ordinary life of a wooden tub in a pit ?—It is like a railway wagon, once a tub always a tub, because parts of it can be repaired and it is as good as new. It is almost impossible to say.

15149. It cannot be the same tub always ?—Most tubs are condemned when they meet with an accident and are put on one side, but the others are sure to have some parts right, and they are rebuilt. It is only when they meet with an accident and get all wrong that they are condemned. The old timber is better than the new in that it is shrunk, and by repairing it up it makes a better box for keeping the dust in than when it is absolutely new.

15150. I suppose you agree that it is desirable to have tubs as dustless as possible ?—Certainly. I think that is the most important thing of all.

15151. Is the cost of replenishing a whole pit with tubs a great item ?—Yes, immense; a very great item.

15152. We have had figures given here by people who have prepared new tubs and put them in right through ?—Yes.

15153. After all, the great question is safety. It is important on this question of tubs, if there is a considerable portion of the mine worked with danger and risk of explosions, such as was the case at Courrières, and you cannot water them—it is desirable at any rate that the dust question should be dealt with in some other way ?—Yes.

15154. After all, it is a question of cost. An explosion in a pit to-day would mean considerably more than the cost of putting tubs in ?—The cost alone, yes; of course safety is the main thing. I may say that we are contemplating sinking new pits elsewhere, and in these new pits we certainly shall put metal wagons in. We shall not bring our old pits on to the new ones. We shall provide iron tubs.

15155. I understood you to say that you do not now fire shots in the main haulage roads when the men are in ?—No.

15156. (*Mr. Smillie.*) I suppose that the chief danger from watering of the floor is heaving of the floor ?—Yes.

15157. If the floor gives way where the roof has been kept up by a crown or props the legs of the props sink down into the soft floor ?—Yes.

15158. You have suggested that you have from 1 ft. to 2 ft. of fire clay.—It is different in different mines; in two or three of the mines we have this fire clay.

15159. Where it is only from 2 ft. to 3 ft. it would be a simple matter to lift that in the main roads and put your props down on to the bottom.—It is not always next to the mine; there is a lot of stuff in between sometimes.

15160. Your main levels there are really driven across cross cuts; they go across gradient, I mean ?—Quite so.

15161. If they are level you must have cut the floor on one side considerably ?—Yes.

15162. You agree with most of the witnesses that the chief source of dangerous dust comes from the tubs in transit to the pit bottom ?—Yes.

15163. The shrinkage of the wood is the chief cause of the openings along the side ?—Yes.

15164. Would it be possible to have little strips of iron put along the outside of those cracks or fissures at a very small cost ?—I do not think that would be very effective because they themselves would be liable to come out, to work loose, and the more ironwork you have about a box the more easily it gets knocked about. I have thought about that, and we do not like trying it. We have small strips of wood put in, cut to lengths and jammed in as soon as a fissure is observed.

15165. How many boards are there in the side of the tub—two or three ?—Three.

15166. If you had a strip of thin wood put securely across the cracks, any shrinkage would still leave the tub dust-tight ?—Across.

15167. Across the fissure a strip of wood like that (*indicating*) ?—That would get knocked off in filling with round coal.

15168. It would depend how it was put on ?—Yes.

15169. If it was bolted on with little bolts ?—We have considered it; it is not because we do not want to spend money, but we do not think that it would practically do us much good. We fill these holes up, as I say, with strips of all kinds of sizes, and we drive them in as soon as possible.

15170. It was only in old collieries such as your own, that you did not wish to renew the tubs, but something might be done to make the tubs more dust-tight than they are at present ?—We have often thought of tongueing and grooving.

MR. WILLIAM HENRY CHAMBERS, called and examined.

The Witness handed in the following Statement:—

15171. (1) The Collieries I have managed for 25 years are in South Yorkshire, and are the deepest of any yet sunk in the county.

(2) South Yorkshire produces about 20 million tons annually, mainly from the Barnsley, the Parkgate and the Silkstone seams.

(3) Very few collieries are working the three principal seams at a less depth than 300 yards, and nearly all may be described as dry and dusty. All the modern pits are deeper.

(4) The Barnsley seam where it is now worked is in a few pits covered with a roof which might stand careful watering, but in the deeper and consequently hotter ones, owing to the hygroscopic character of the overlying bind, a change from a dry to a wet state of the weather is very perceptible in the increase of falls occurring in the roadways and workings, and thereby augmenting the risk of injury to workmen. The floor consists of spavin which swells and lifts up in the roadways on the application of water. I put in sections of roadways in the Cadeby mine working this seam at a depth of over 760 yards deep, showing how the roof subsides in the roadways following the workings, notwithstanding the pack walls which are built to support it. Overcasts have to be frequently reconstructed, illustrating the difficulty in maintaining roads at great depth. At Cadeby colliery, owing to interruption by a fault, a road has been driven across the measures to re-win the coal. This road has been completely closed up six times, notwithstanding all efforts to preserve it. Composite arching of steel and concrete is now being put in at a cost of £17 a yard, but it has not been in existence long enough to prove if of adequate strength. No less than 430 men are required to maintain the roadways for 110 stalls. I also put in a table of hygrometer tests made on the 5th October, 1903, by Mr. Pickering, the late inspector for No. 5 District:—

	Wet bulb of	Dry bulb of	Quantity cub. ft. per min.
Surface	54	58	—
Underground—Boxhole .	62	69¼	—
East Return	73	84½	63·900
West Return 1	74¾	85½	48·800
West Return 2	74	88	—
West	—	—	—
59° Junction (1,000 yards in-bye)	68¾	78¼	—
12° Return	83	91	—
12° Stall	80½	88¼	6·000
Middle place	88	95	—
40° Return from 12° Stall near doors	83	90	11·520

Digitized by Google

Mr. W. H. Chambers.

7 Mar. 1907.

On this occasion Mr. Pickering selected a place on one of the roadways and had two buckets of water splashed on the side where it appeared to him to be sound. He left this place to complete his observations and returned after an interval of 1½ hours to see the effect of the watering. He found about a ton of the bind had crumbled, and some had fallen, the remainder appearing ready to do so. Mr. Pickering remarked the effect of the test was a strong argument against watering the roads in this mine. In 1887 water was turned into a portion of the workings to extinguish a fire. It was effectual, for very quickly the roads became as solid as if they had never existed.

(5) The Parkgate seam has a variable roof, which consists in some places of sandstone rock immediately above the coal, but very often with a clod or inferior fireclay intervening. The rock would stand watering, but the clod would certainly not. The floor is similar to that of the Barnsley seam.

(6) The Silkstone seam has a similar roof to that of the Barnsley seam in the deeper mines and would not stand watering. The floor also is of like character.

(7) The other seams have different features and I esteem them of minor importance.

(8) I am of opinion that a general watering of the roadways is impracticable :—

In the deep, dry and dusty Barnsley pits ;

In Parkgate pits where the roof is of clod ;

In deep Silkstone pits ;

In some of the other seams.

I have always been alive to the possible danger of coal dust in mines, and have for many years tried means to deal effectually with it. More than 20 years ago I tried steam and also water sprays in the intake air at intervals, but owing to the damage done to the roadways, it had to be quickly discontinued. I also have tried salting a long road but I found it did not abstract from the air sufficient moisture to make it damp as I expected. Even now, wherever it is possible, watering is done on the floor of the haulage roads by means of hose attachments to the water pipes which are practically laid all over the mines. We dare not put any on the sides, but it would perhaps be possible in a very limited part to water the roof if it could be kept from the sides. The dust, wherever it accumulates to what is esteemed an undesirable extent, is swept up and sent out of the pit.

(9) My experience has been that this district is in advance of most in taking precautions for safety, and generally in advance of legislation, and in my presidential address to the Midland Institute, and on other occasions, I have expressed this opinion. As an instance, I myself, being desirous of preventing the dust made on the screens from being carried into the mine by the ventilating current, gave the matter careful thought and instituted many inquiries as to how this could best be prevented, and for that purpose, being unaware of any adequate means in operation in this country, visited the Mines de Dourges, the neighbouring colliery to the now noted Courrières Collieries, before the explosion, to see a dust exhausting plant, and shortly after installed a similar plant at the Cadeby Colliery. Mr. Walker, the District Inspector, referred to this in his evidence before the Commission. I designed the safety gates to fix to cages in which men ascend and descend the shafts, which Mr. Walker referred to in his last Annual Report.

Some time before Mr. Walker referred to the matter in his evidence, I commenced to construct a new type of pit wagon as far as possible dust proof.

I adopted and rigorously enforced a method of systematic timbering as far back as 1879, which system was the subject of an Order from the Home Office more than 20 years after, the outcome of an investigation of French practice, and I have not had to vary what I first initiated to conform to that Order.

Other appliances and methods I might refer to, but I merely mention these as confirmation of my opening statement. Most other owners and managers have done likewise in taking measures to ensure safety. I do not know whether there ever has been an explosion of dust in any of the seams referred to, but for the last 40 years there has certainly been none.

(10) It appears to be lost sight of that it is a colliery-owner's interest to preserve the safety of the mines in which such a large capital is now invested, for the consequences, including the compensation to be paid to workmen injured or killed, of an explosion would be much more serious than they used to be.

(11) The colliery owners do not object to extensive watering or the establishment of dust-free zones, if these are practical and reasonable in number and extent.

(12) I am of opinion that at least the colliery owners should be allowed to adopt in lieu of such possibly and probably ineffectual attempts to minimise the effect of an explosion, the most careful means to remove the cause of it, such as sufficient ventilation to well dilute the explosive gas emitted, the abolition of all naked lights or other sources of possible ignition of a dangerous mixture, including shot-firing, open electric motors, exposed electric cables, and such like. Probably in many cases the owner would elect to increase his working cost by adopting these measures as an alternative to the very much larger expense of attempting to put in force under most difficult circumstances the proposed remedies.

(13) Many hold the opinion that it is impossible to explode coal dust otherwise than by detonation, *i.e.*, shot-firing or an initial gas explosion. I am of opinion that proper tests under working conditions should be made to test the theory before proceeding to legislate on an unknown quantity.

(14) In this district for a long time past every effort has been made to discontinue shot-firing, and I am unaware of any colliery where it is practised in coal getting, except in very shallow and safe mines. No shots, so far as I am aware, are fired during working shifts except in stone drifts where there cannot be any danger arising from either coal dust or gas. All these shots, I believe, are fired by electricity.

(15) Much can be done to prevent the accumulation of dust by rendering the wagons dust-tight. I do not think it necessary to cover them in, as any dust contained is quickly protected by the rougher coal, amongst which it percolates and is removed from the force of an air current. If the manipulation or character of the coal produces much dust on the heapstead, the screens should be either situated at a distance from the pit mouth, the dust collected from the screens, &c., where it rises, or the downcast shaft should be damped to cause the dust to be deposited at the bottom. Slow haulage is very effectual in preventing the accumulation of dust in roadways.

I doubt very much if a dust-laden atmosphere, which is the medium for depositing dust on the roof and sides of roadways, is not explosive under favourable conditions, independent of an additional quantity that may be added thereto by a blast, and if so, the watering of roof and sides is no use unless the atmosphere is also sufficiently damped to render the suspended dust harmless.

(16) In attempting to devise a system of watering, it is very necessary to take all the local conditions into consideration. What is most suitable for one pit may not be at all good for another. Witnesses are apt to recommend a method most favourable to their own circumstances. Inspectors are ready naturally to advocate anything they conceive conducive to safety, without sufficient regard to the difficulties and expense to be encountered in the scheme. One of them in admitting that some roofs would not stand watering, thought they would get used to it the same as a lump of quicklime does. It does not do so until it is reduced to powder. The argument is analogous to accustoming a horse to live without food.

If complete watering is impracticable, and ordinary arching will stand, I think the zone method is better than nothing, and I agree with previous witnesses that the clean and wet lengths of arching should be sufficient to stop the progress of an explosion. The length, I surmise will vary according to the area, character of the dust, and velocity of the blast. These lengths and areas I think should be settled after practical experiments have been made to prove what is necessary and effectual. Where the naked strata will not stand watering, and where it is difficult to maintain arching, then I cannot suggest any alternative except to exempt the mine from watering, as in Germany, and adopt all other reasonable means for minimising the risk, which is the object of the watering scheme.

(17) I have had experience that a humid atmosphere has a very depressing effect on the workman. In

Digitized by Google

dealing with underground fires as little water is used as possible, in order to keep the ventilation dry, to enable the men to exert themselves. Even in the roads near the shaft, in a deep mine, the men are affected by the state of the weather. If the day is fine they work in much greater comfort than when it is rainy or foggy.

(18) Where shot-firing is practised in the getting of coal I think the present regulations are sufficient; but, of course, they should be strictly observed. I think the South Yorkshire method of only blasting in roadways between shifts could with advantage be generally adopted.

15172. (*Chairman.*) You are a Certificated Colliery Manager, a Mining Engineer and Managing Director of the Denaby and Cadeby Main Collieries, Limited?—Yes.

15173. You are past President of the Midland Institute of Mining, Civil and Mechanical Engineers, and you have had 40 years' experience of mining?—Yes.

15174. You are acquainted, I think, with most of the mines in South Yorkshire and many in West Yorkshire, Derbyshire and Nottinghamshire; and you have on various occasions observed mining methods in France and Westphalia?—Yes.

15175. Are the classes of mines which you have seen in France and Westphalia very much the same as those which you have been accustomed to in Yorkshire, Derbyshire and Nottinghamshire?—Some of them are of the same class, but there are some which were much more dusty than any I have observed in our district.

15176. Very dry and dusty and also fiery mines?—Yes; and the character of the dust has been lighter, and there has been much more of it than any I have observed in this country.

15177. Are the mines in Yorkshire, Derbyshire and Nottinghamshire of which you have had experience, very much of the same character, or are they different?—They vary; but there is not much difference between the principal seams in the South Yorkshire District except in the shallow mines.

15178. But in Derbyshire and Nottinghamshire the mines are somewhat different, are they?—They are somewhat different.

15179. The general characteristics you say are dry and dusty, but not so dry and dusty as some mines which you have been accustomed to abroad?—That is so.

15180. And you have had experience in very deep mines, over 300 yards in depth?—Yes. In the South Yorkshire District the mines produce about 20,000,000 tons annually from the Barnsley, the Parkgate and the Silkstone seams. The others are mostly smaller pits, and they have different characteristics, but of minor importance. All the modern pits are very deep ones now. The old mines that are working in Yorkshire at 300 yards depth have been very rapidly exhausted.

15181. You say that the Barnsley seam where it is now worked is in a few pits covered with a roof which might stand careful watering. Have you not tried watering them at all?—Yes.

15182. You are able to say from your experience that they can stand watering, I suppose?—Yes. I have some sketches here, which I will put in, showing how the roof subsides after the coal workings.

15183. But could you tell the Commission how much watering they could stand without the subsiding of the roof? You say they could stand careful watering?—Yes, in some very rare instances. There are some roofs in our own pits which in a very small portion might stand watering if we could keep the water from the sides, but it would be very dangerous indeed to water the sides.

15184. You can water the floors and roofs in some places?—In very few places.

15185. And to a very slight extent?—That is so.

15186. Have you done what watering you can, or do you do no watering?—We do water the floor very carefully where it will stand it.

15187. Do you find that watering the floor is fairly efficacious? It has been suggested to us by some witnesses that watering the floor does more good than would at first sight appear, inasmuch as the ventilation raises the dust from the sides and roof, and that dust gets deposited by-and-bye upon the floor, and therefore if you water the floor you to some extent hinder the dust accumulating on the sides and on the roof?—No, I have not found that. More than 20 years ago I tried different methods of damping the air and watering, and also salting the roadways, but the salting was not effectual because it did not take up sufficient moisture from the air to do any good; the watering of the floors reduces the dust there and it does not float about, but it has not any effect in reducing the quantity of dust which is on the sides and which is gathered up from the ventilation as it passes along and is deposited on the sides instead of on the floor; the watering of the floor does not reduce that.

Mr. W. H. Chambers. 7 Mar. 1907.

15188. You have a particularly difficult mine to contend with in the Barnsley seam, I understand. You say you have been obliged to put in arching of steel at a cost of £17 per yard, and even after that expense you are not quite sure that without any watering at all you can keep up the roadway, as I understand?—That is so. We are now re-opening the road after the faces have advanced nearly half a mile away. It has been driven and opened out no less than six times, and we have adopted close wooding and various ways of securing it. Now we are trying a composite arching of steel girders and concrete, which is costing £17 per yard to put in; it has not been in sufficiently long to know whether it will stand.

15189. Of course, in a case of that kin it would be quite impossible to apply watering; you could not do anything with it?—No.

15190. You state that once you tried the effect of slight watering on one of the roadways where you had two buckets of water splashed on the side and at a place where it appeared to be sound, and you say the result was that a ton of the bind had crumbled and some had fallen, the remainder appearing to be ready to do so after an interval of 1½ hours?—That is so; that was in Mr. Pickering, the inspector's presence; he wished that to be done.

15191. You say that in 1887 water was turned into a portion of the workings to extinguish a fire; it was effectual, for very quickly the roads became as solid as if they had never existed?—That is so.

15192. So that it is clear that in places of that kind it would be impossible to water?—Yes.

15193. But you do water the floor where you reasonably can do so?—Yes.

15194. In Paragraph 8 of your Statement you say that you think a general watering of the roadways is impracticable in the deep, dry, and dusty Barnsley pits, in the Parkgate pits, where the roof is of clod, in the deep Silkstone pits, and in some of the other seams?—Yes.

15195. You go on to say that you have always been alive to the possible danger of coal dust, and have for many years tried means to deal with it effectually, and that more than 20 years ago you tried steam and also water sprays in the intake air at intervals; but, owing to the damage done to the roadways, it had to be quickly discontinued?—Yes.

15196. Then you say you have tried salting, but it did not abstract from the air sufficient moisture to make it damp, as you expected?—That is so.

15197. Was the air too dry to have any effect upon the salt?—Yes, it quickly disappeared; and even when we had sprays in the air the floor was wetted, and the sides, and it caused falls, and yet it did not carry very far in with the air, and it was as dry and dusty, perhaps, 150 or 200 yards beyond where it was saturated in that way as if we had never done it.

15198. Salt would have some effect in making the air dry, would it not?—It was not on the salted road; but I am giving it as an instance that the air is so dried by contact, I take it, with the strata, that it soon dries it and takes all moisture out of it. We perceive the effect of wet and foggy days; we have many more falls on such days as those near the pit bottom than we have at other times; I suppose that is on account of it absorbing moisture from the air.

15199. You say that it would perhaps be possible in a very limited part to water the roofs. Have you ever tried watering the roof, and seen the effect of it?—I have not.

15200. You say the dust, wherever it accumulates to an undesirable extent, is swept up and sent out of the pit. Do you sweep it up dry, or do you wet it?—We sweep it up dry.

15201. You would get rid of it much more efficaciously, I should have thought, if you had watered it than if you swept it up?—We dare not do that.

15202. You cannot do even the slight watering that would be necessary to damp the dust so that you could take it away?—I do not think you could get it up quite so well, because it is swept up, and it is an uneven surface, and we sweep down the sides where we can, where there is a quantity of dust on the sides as well as on the rough

Digitized by Google

Mr. W. H. Chambers.

7 Mar. 1907.

floorway, and if it were damped it would make it muddy, and we could not collect it so well.

15203. You think not?—I do not think so.

15204. But if you sweep the dust dry, does not the dust disperse and go somewhere else?—We have to take it on the air side, and that which is disturbed we have to catch up, so that we have it all clean behind us.

15205. How do you mean, catch it up?—We sweep the road up in the direction of the current of ventilation, so that it is all clean behind.

15206. Then it goes on with the current of air, I suppose, and deposits itself somewhere else in the mine in course of time?—Yes, it goes on towards the workings, you see.

15207. That tends to make the workings dusty?—Well, it is usually buried; there is not much dust in the stalls; of course, as it is deposited it is soon left behind.

15208. Then you say you would be very anxious to deal with the dust made on the screens. Do you consider that the dust is particularly explosive—more explosive than other dust?—No, except that it is dangerous and it is not desirable to have it in the mine. For that reason I have been for a very considerable time giving the matter careful thought, and I have instituted many inquiries as to how this could best be prevented, and for that purpose, as I was not aware of any adequate means in operation in this country, I visited the Mines de Dourges, the neighbouring colliery to the now noted Courrières Collieries, before the explosion, to see a dust-exhausting plant; I shortly afterwards installed a similar plant at the Cadeby Colliery. Mr. Walker has referred to that in his evidence before this Commission.

15209. Mr. Walker has already explained what your plant was?—Yes.

15210. Did he give a sufficient explanation, or do you desire to add anything to his explanation?—No, he described it very well.

15211. Then you say you have designed safety gates?—Yes. I simply refer to that question of safety gates. Also I commenced more than a year ago to construct a new type of pit wagon, as far as possible dust-proof, for dealing with this matter.

15212. What is your method of making the wagon dust-proof?—It is an iron bottom with flanged edges, and the sides of the wagon are put down inside that, and then where the joints of the boards are it is grooved and an iron tongue is put in, so that if the timber is dry, instead of opening the crack there it is tongued, practically like a wooden floor in a room, except that instead of the wood being tongued into it there is an iron strip put in.

15213. Then I understand it is a combination of iron and wood?—That is so.

15214. Do you find that it stands wear and tear and that there is no leakage, or very little leakage, from it?—Yes, it is stronger than it would be if it were tongued and grooved with wood.

15215. How long have those wagons been in operation?—I have been making them since more than a year ago.

15216. You find they are efficacious in stopping the falling of dust?—Yes; it is a great improvement.

15217. They are almost entirely dust-tight, are they?—Yes.

15218. You say you adopted, and rigorously enforced, a method of systematic timbering as far back as 1879, which system was the subject of an Order from the Home Office more than 20 years after?—Yes.

15219. I am afraid that Order of the Home Office of systematic timbering has not done much good in regard to stopping accidents from falls of roof and sides, has it?—I only refer to these matters, and other appliances and methods which I might mention, as a confirmation of the statement that we do everything it is possible to do to enhance the safety of the mines.

15220. Have you any opinion yourself as to this systematic timbering which you recommended, or have you any explanation to give with regard to why it is that this system of systematic timbering does not seem to have prevented accidents?—Yes; because I believed, and I believe now, that, generally, colliery owners were doing all that was possible to preserve the safety of the mines and the workers in them before there was any Order at all, and, therefore, it is almost impossible to make any Orders which will improve the present conditions and the conditions which existed then.

15221. Therefore, if you adopted and rigorously enforced this method, you did not expect much good to come out of it?—Well, I had it in operation 20 years before the Order was made, and I am carrying it on on the same system to-day.

15222. Then you say that the Order of the Home Office did not make any difference whatever—that this systematic timbering was being carried out before the Order just as much as it was afterwards?—That is so.

15223. (*Mr. Ratcliffe Ellis.*) At these particular collieries?—Yes, at our collieries.

15224. (*Chairman.*) Therefore, it does not surprise you at all that since the Order came out there has been no diminution in accidents from those causes?—No, because I believe that most managers were doing all that they thought was necessary, and all that they could conceive as being proper, to preserve the mine and the workers therein from danger.

15225. Then you say that in your mines and in the mines which you are acquainted with, for the last 40 years there has been no dust explosion?—No explosion at all.

15226. No explosion at all of dust or gas?—No explosion at all in those seams for 40 years.

15227. That is in the seams which you know of?—Yes.

15228. Therefore, in no mine with the working of which you are personally acquainted has there been any explosion for 40 years?—That is so. The last one I was down was the Swaithe Main Colliery. I was down there about three days before it exploded.

15229. That is about 40 years ago?—About 40 years ago as near as I can remember.

15230. You think that instead of attempts being made to minimise the effect of explosions, colliery owners ought to turn their attention to the means of removing the cause of explosion?—I think they ought to have that option.

15231. And you suggest the abolition of all naked lights?—Yes.

15232. Then do you think there ought to be an abolishing of all naked lights in all coal mines?—No, I do not go as far as that. I say where there is any danger of an explosion being initiated in a dry and dusty mine, I think it is desirable that that mine should be worked with safety lamps.

15233. Then you think that the general rule about naked lights ought to be made more stringent?—Well, I do not know; I say that safety lamps ought to be used where there is danger of explosion.

15234. That is the case, surely, under General Rule 8; is not that sufficient?—I think that the present rule is sufficient.

15235. General Rule 8 provides that "No lamp or light other than a locked safety lamp shall be allowed or used (*a*) in any place in a mine in which there is likely to be any such quantity of inflammable gas as to render the use of naked lights dangerous"?—That is so, and that, I think, is sufficient.

15236. Then you would say that the rule is not carried into effect as carefully as it ought to be?—No, I do not say that. I say it should be.

15237. Well, I suppose all rules ought to be carried into effect if they are put into an Act of Parliament?—Yes, but there is a great objection to the use of safety lamps in some collieries; I think they would be introduced into some collieries if there were not some difficulty on the part of the men.

15238. There is a special rule in Lancashire. It provides that: "The manager shall see that locked safety lamps only are used in every coal seam of the mine to which these special rules apply in which an explosion of inflammable gas, causing any personal injury whatever, has occurred within the previous twelve months." Do you think that would be a good rule to adopt generally in coal mines—that where there has been any explosion of inflammable gas causing injury during the preceding twelve months, it should be obligatory to use safety lamps?—That depends upon what caused the explosion; it might be shot-firing that would cause it.

15239. Or there might not be any gas at all?—I think that the cause of the explosion ought to be removed.

15240. It is "an explosion of inflammable gas." So that an explosion by shot-firing without inflammable gas would not come under that special rule?—No.

(*Mr. Ratcliffe Ellis.*) That is in addition to the rule it goes on to say "or," and then follows the general rule.

Digitized by Google

15241. (*Chairman.*) However, you have no practical suggestion to make as to strengthening the rule; you merely say you think it ought to be carefully carried out?—Yes, I think it is sufficient if it is carried out.

15242. You go on to say in paragraph 13 of your statement that you think proper tests should be made to test the theory of whether it is possible or not to explode coal dust otherwise than by detonation. I understand that numerous experiments have been made in that direction, but the general opinion is that there is practically no danger of explosion of coal dust alone, unmixed with gas by a naked light—that nothing less than a detonation will cause such an explosion?—Yes, that is how I take it.

15243. That I think is the general opinion. As regards shot-firing during working hours you say, "No shots, so far as I am aware, are fired during working shifts except in stone drifts." Is that under the rules, or do managers take care that it is not done, without any rule being specifically made?—It is done voluntarily, and was done irrespective of any rule in operation in all the mines which I am acquainted with working these seams.

15244. Then there would be no objection, I suppose, to making it a Special Rule in your mines, or even perhaps a General Rule throughout the Kingdom, that no shot should be fired during working shifts?—I would not go as far as that; I can only say that that is the practice in these collieries, because the managers consider it is dangerous to do that, and they can manage without it.

15245. Do you think that they can manage without it in all mines, or have you not had sufficient experience to say that?—I have not sufficient experience of every district to know how they work; I am speaking about my own district.

15246. Then you say you do not think it necessary to cover in wagons; I think that is the general opinion?—Yes; I understand it is not proposed to do that; I only wished to make it clear.

15247. You say as regards screens that they should be either situated at a distance from the pit mouth, or the dust should be collected from the screens, &c., where it rises, or the downcast shaft should be damped. Would there be any objection in your mines to damping the downcast shaft?—I should not adopt it, but I know it is done in one mine in Yorkshire in which there is a spray put on the downcast shaft. I do not like that; I would prevent the dust going down the shaft rather than deal with it in the shaft.

15248. But would it render the atmosphere unhealthy to work it down below or is there any objection to having a spray?—Yes, I think it is a nuisance; it deposits the dust in heaps and down the shaft sides and makes a mess down in the bottom. I think it is better to keep it out altogether; but that is a remedy if they cannot keep it out otherwise.

15249. Then you recommend slow haulage as decreasing the deposit of dust?—Yes, I have experienced a great difference from that. On one road in one of our mines the wagons used to be run with quick haulage, and I substituted an endless rope, slow running, by which it only runs at a mile and a half an hour, and the quantity of dust that has been produced upon that road since shows a most remarkable reduction. That is the effect of carrying the coal slowly instead of quickly.

15250. Then would you suggest that anything should be done in the way of regulating the pace at which trams should be allowed to run?—No, I cannot suggest that, because it would be very hard on the old mines to interfere with a system which those mines have been laid out for. In order to get the quantity of coal out that they produced they have had in some cases to expedite the haulage; but I do not think it is desirable to do that if they can do without it.

15251. You say with regard to watering, that if complete watering is impracticable and ordinary arching will stand, you think the zone method is better than nothing. Would it not be a great deal better than nothing: might it not be almost as good as complete watering?—Well, I do not know. I do not think it is as good as abolishing the danger of initiating an explosion. In my opinion, it is not so good to deal with it after it has occurred—to confine it. I think there has not been sufficient attention paid to doing away with an explosion rather than to limiting its area.

15252. You say that you agree with previous witnesses that the clean and wet lengths of arching should be sufficient to stop the progress of an explosion; but what do you say to clean lengths of arching that are not wet; supposing that you had an arched roadway which for some reason or other you could not wet because the arch would not stand it and you cleaned it, do you think that would stop an explosion?—I am very doubtful whether that would be sufficient. I think that the progress of an explosion is carried on by the dust laden atmosphere which deposits the dust upon the roadways, and that a dry arched way would not damp the ventilating current sufficiently to cause that dust not to propagate the explosion through the length; and I think the damping of it may impart sufficient moisture to the air to cause that suspended dust to be deposited. But that is a question for experiment; I think it ought to be investigated.

15253. Then you say that a humid atmosphere has a very depressing effect upon workmen. Have you any statistics to show how far the death rate or the health of the miners is affected?—No, I only say that from observation: I know that a humid atmosphere has a very depressing effect. In dealing with underground fires as little water as possible is used in order to keep the ventilation dry.

15254. Do you find that the men become ill as well as depressed?—I do, particularly when they are working in hot places they become ill.

15255. (*Mr. Cunynghame.*) You rather said you thought it would be a good thing to do more than is at present done to do away with the initiation of explosions?—I said I think it is better to give the owners the option of abolishing the risk of an explosion even if they incur greater expense in doing so, such as the abolition of shot-firing and the introduction of safety lamps—abolishing the use of naked lights altogether. It would probably be causing more expense, but I think it would be more effectual to adopt those means rather than impose a condition upon the owner which will be more expensive than that.

15256. You mean you would allow things of that kind as alternatives to the watering?—Yes; I think there should be an option to do it except in some places, the same as they do in Germany—exempt the mines.

15257. There have been about seven different remedies suggested to us at different times for the prevention of the spread of explosions. I will be very brief in dealing with some of them, because your views have been expressed already. Total watering throughout you think it is impossible to make compulsory?—I agree with that.

15258. Now as to the use of salt and other materials of that kind?—My experience has been that it is not effectual.

15259. What would you say to the suggestion of cleaning the floor and walls from dust; how far could that be done?—I think that should be done as far as it reasonably can be. We do it ourselves.

15260. But I suppose it would be impossible to clean the floors of dust in such a way as to make the mine quite safe?—Oh, to make it so that you cannot dirty your hands it would be impossible.

15261. But if you get on as much dust as would dirty your hand would that be a source of risk still?—Well, I suppose it would. But my impression is that the propagation of an explosion does not arise because the dust is on the sides and the floor of the roadway. I think it is because of the suspension of the dust that is in the ventilating current; that is the cause of the deposition of the dust on the sides of the road.

15262. Of course if the dust gets up on to the top it must have been carried by the air in some way or other; it must have got up there—it could not have been put there?—That is so; and when it is in that condition and is depositing dust at that rate I think it is possibly under conditions which will propagate an explosion.

15263. Yes, but you know that the explosion wave can also stir up the dust that is lying there, even when there is not a particle in the atmosphere?—Well, I think it has had to be carried there to do that.

15264. I agree, but still it stirs it up even when it is quite at rest. That you must admit, I suppose, from our knowledge of explosions?—I think that is an after effect.

15265. At all events it is a danger?—I think it is an after effect of the explosion; that is my idea about it. Certainly it stirs it up, but I think it is an effect which follows the explosion, not the cause of it.

15266. You mean that an explosion would be quite impossible if you had a very dusty road and if the air was perfectly clear?—I do. I do not think it would be propagated under those conditions; if the air was clear it would not matter how much dust there was about it; I do not think the explosion would travel.

15267. The theory that the wave which carries the flame stirs up the dust that was there before, you do not agree

Digitized by Google

Mr. W. H. Chambers.

7 Mar. 1907.

with ?—I think that explosion would go faster than the wave.

15268-9. I am afraid the professors are rather against you upon that ?—I cannot help it; it is only my opinion.

15270. With regard to the use of wet zones, that you would agree with, at all events, in many places ?—Well, it is possible. But you see witnesses generally are prone to advocate conditions that apply particularly to their own cases, ignoring what is applicable generally.

15271. At the same time, if wet zones would be possible in a very large number of mines, perhaps in four-fifths of the mines in the country, they would be very effective, would they not ?—Well, as I have said, I think it is better than nothing.

15272. I should think anything must be better than nothing; it is hardly much to say that ?—Yes.

15273. With regard to dry and dustless zones, what is your opinion ? That is the fifth method which has been proposed.—I say that we try to remove the dust as much as we possibly can, and I think it is advantageous to do so.

15274. The question is this: would it be sufficient to have dry and dustless zones and nothing else ?—I do not think so, because if there is a blast, and if the wave theory is a correct one, I think the wave, if it travels before the explosion, would carry the dust in, and it would carry through a length of dry clean roadway. That is why I say I think it would be necessary to damp it also in order to let the dust fall.

15275. If your theory is as you stated, it does not appear to me that the wet zone would be much use either; the dust would be driven along whether it is wet or not ?—I do not think there has been enough experiment in regard to this matter, and I think it ought to be experimented upon before it is legislated upon.

15276. The sixth method is that of dust-tight wagons; that you are in favour of where it is possible ?—Yes.

15277. What do you say to watering the coal in the wagons ? That is the seventh method.—A good many coals would not stand it, and I do not think it is at all necessary where the wagons are dust-tight; and I approve of that.

15278. Of course in the case of a perfectly dust-tight wagon none of the dust could get away from the bottom of that wagon ?—No.

15279. But then a previous witness pointed out that the air may drive away dust from the surface where the coal is heaped up in the wagon ?—I do not think it would be on the surface, because it would very quickly percolate down amongst the rougher coal and be buried and protected from any air current on the top of the wagon.

15280. Then you do not seem to be inclined to place much importance upon watering wagons if they are dust-tight ?—If they are dust-tight, I do not think it is necessary at all, and I do not think it would be much advantage, if any.

15281. (*Sir Lindsay Wood.*) I think you said that generally throughout your district watering of the main roads would be impracticable ?—That is so.

15282. But you say in some parts you could water the roof and the floor ?—Yes.

15283. But not the sides ?—That is so, especially in the Parkgate where the rock comes on to the roof it would be possible; but where the clod is on the top—and that very often occurs where clod intervenes—it would be impossible, you fetch it down. In fact in the Barnsley pit the way in which it is generally brought down is that the man takes a little water and scatters it on and very soon after it falls; that is how they do the ripping in the roads.

15284. But you said in some cases you could water the bottom and the top but not the sides ?—That is so.

15285. Would that be efficacious for laying the dust ?—I do not think so. There is not much remains on the top; it is more on the floor and the sides that the dust lodges.

15286. At all events, there would be sufficient remaining on the sides to prolong the explosion through that part ?—If it has that effect, which I very much doubt, you remember my theory is that it is the dust-laden atmosphere that deposits the dust on the sides, and it is in that condition that it carries the explosion. It is dust-laden before it is distributed even by a wave, in the air; it is carried with it—it is always there.

15287. Does not the heat of the explosion distil the gas out of the coal dust ?—It will when it is in suspension in the air, but I do not think it would when it is in bulk on the roadways or on the sides.

15288. Does not the mere rush of the explosion cause the dust to be in suspension in the air ?—No, it is suspended in the air before the explosion, or else it would not be carried into the roadways.

15289. But it is in the roadways to begin with ?—Yes, but it is always in suspension in the air; it is that which causes it to accumulate on the roadways.

15290. But the mere blasting—the explosion—agitates all the dust and puts it into suspension and brings it in larger quantities ?—I daresay it does, but is that not after the explosion has passed ?

15291. No, I think not ?—I doubt it. I say that is why I think there ought to be experiments made on such a scale that they would prove whether that is so or not.

15292. You rather advocate stopping the cause of the explosion than stopping the effects of the explosion ?—Undoubtedly that is so.

15293. How would you propose to do that ?—By taking every precaution possible; that is, in gaseous mines, where there is likely to be danger of outbursts from some extraordinary condition causing sufficient gas to be carried in there to approach an explosive mixture, with coal dust if you please, to abolish naked lights altogether and to do away with shot-firing. If the owner is willing to take these precautions and enhance his cost to the extent of adopting those measures I think he ought to be relieved of an obligation to water or provide zones, which may be impossible in some cases—well, nothing hardly is impossible, but it would be nearly impossible in some cases, and at any rate, it would be very very expensive to do it.

15294. You mean to provide zones ?—To provide arching, and to provide these zones. I say in our pit (which is one of the deepest Barnsley pits and which may be typical of all the future pits, not only the Barnsley, but the Parkgate and the Silkstone pits) in my opinion there would be very very great difficulty in maintaining archings if you attempt to make these zones.

15295. If that theory is correct, that the dust is not carrying on the explosion, there would be no object in having the zones ?—That is so; and that is a theory which requires investigating by experiment before there is anything adopted to compel this to be enforced.

15296. Then you are of opinion that the blasting is one of the chief sources of explosions ?—I think it has proved to be so—that most of these dust explosions have originated from it being detonated by means of a shot either with an admixture of gas with the dust or without it. I think they have all originated from shot-firing.

15297. All the large explosions ?—Yes.

15298. (*Mr. Wm. Abraham.*) Then is it your opinion that all the explosions which have happened have originally been caused by the want of observing one of those conditions which you have named in your statement ?—No, I should not like to say that. The precautions may not have been sufficient. I say it may be possible to minimise the risk of an explosion, rather than minimise the effect of it, by the abolition of shot-firing under any conditions.

15299. But shot-firing is only one of the numerous conditions you have named. I think after hearing what you have said, I am only putting to you a very fair question: have all the explosions which have happened been caused by the want of observing one or other of these conditions which you have laid down ?—Either originated from an explosion of gas or shot-firing—under some conditions.

15300. Have you experienced any large spontaneous outburst of gas from blowers, and so forth ?—Yes.

15301. Then do you not think that some of these explosions which have happened have been caused by certain causes which you could not provide for ?—Yes; I could name you two instances, one that occurred in 1871 at Thorncliffe in the Silkstone seam where there were about 55,000 ft. of gas given off out of the floor, which extinguished every light there was in the district in one working, and which was given off in a reducing quantity for somewhere about seven or eight hours afterwards; and there was no accident then. Another occurred at Denaby about 23 years ago while I was there; that was an outburst which occurred which extinguished all the lamps in the district, and nothing happened.

15302. That is rather an indirect answer, but it leads me to put my question again; are you, then, distinctly of the opinion that no explosion has happened unless one of these conditions has been broken, or that there has been a want of observing one of these conditions ?—I do not

Digitized by Google

know how I can put it plainer than that. I do not quite apprehend what you wish me to express an opinion about; is it that the explosions of coal dust have originated through an ignition of gas or shot-firing under conditions that are not safe.

15303. Take any kind of explosion of gas to start with—because the dust is a secondary consideration.—Certainly.

15304. In your opinion, has no explosion ever happened unless it was through the want of observing one of the conditions that you have mentioned in your proof—either insufficient ventilation, naked lights, shot-firing, electric motor, exposed electric cables, and so forth?—Yes, I think that is how they have originated.

15305. Then you think that an explosion cannot happen unless one of those conditions exist?—Naked lights or shot-firing or something to ignite it. Yes, I do. I do not think there has been an explosion without that.

15306. Is it not now within the power of the employers, without further legislation, to provide for that condition of things?—Yes, and we are doing it as much as possible in Yorkshire.

15307. Then you do not want further power to make them do that?—No, they are doing it voluntarily.

15308. And explosions have happened?—Yes; not of recent years, since these precautions have been adopted.

15309. Is it not because explosions have taken place and a large number of lives have been lost that we are sitting here to find out what is necessary to be done?—Yes, I take it it is so.

15310. Then is it not necessary that some new provision should be made in order to compel the carrying out of the conditions that you have laid down here?—Yes, I should agree.

15311. Then it would be no use allowing the employer to have his own free will in regard to having the option of providing against what we propose?—I think there are certain seams of coal that are known to be dangerous with regard to which the inspectors have now power to require the use of safety lamps and that naked lights should be abolished, and also to require that shot-firing should be carried on under conditions in those seams. I think those powers which are already existing, if they are exercised, are sufficient, as they are already in operation, to prevent explosions.

15312. Without any further regulation or provision at all?—I think so.

15313. All these explosions which have happened in the country have been caused by the neglect of some necessary precaution?—Well, in the case of a colliery where there has never been any gas found before, I think that is an accident; you could not prevent that.

15314. I do not think it is for the purpose of dealing with that kind of colliery that we are sitting here; it is to have something done in collieries which are known to be highly dangerous?—We have stopped explosions in our district, that is in South Yorkshire, by taking these precautions; and I think if that policy is carried out it will answer what you are sitting here for.

15315. The explosions that used to take place in all these old districts were caused by the neglect of necessary precautions?—By not taking the precautions which are existing to-day.

15316. Then at that time it was for the want of observing necessary precautions?—It was that they did not take the precautions which are taken now. I do know that.

15317. Taking all the precautions that you have named here, are we to understand that an explosion is impossible?—It is very hard to say that an explosion is impossible, but I say that the risk of explosions would be minimised better in that direction than it would by limiting propagation.

15318. Then it is possible that one explosion, or two or three explosions, could happen in highly-dangerous districts when all these precautions have been taken?—Anything is possible.

15319. That being possible, is it not necessary to provide something to prevent the extension of explosions when they do happen?—If it can be reasonably done.

15320. Is a dry zone or a wet zone an unreasonable requisition?—It may go to this extent, that you could prohibit any dangerous seams being worked at all; that would be safe.

15321. But we have had evidence here that in collieries with the greatest possible physical difficulties in a certain district, and in a dangerous district, where the precautions had been taken, still accidents have happened?—And they will happen under any conditions.

15322. Then if they will happen under any conditions it is necessary that some provision should be made to prevent the extension of the explosion when it has happened?—I take it that that is what you are sitting here for—to make the best conditions that it is possible and reasonable to make to prevent explosions.

15323. (*Mr. Ratcliffe Ellis.*) What is the depth of the deepest seam which you are working?—The deepest shaft in Yorkshire at present is our own; we are working at a depth now of about 800 yards. There are others which are approaching that depth, and there are some being sunk which will be deeper.

15324. Is that the depth of your shaft?—763 yards is the depth of the shaft.

15325. And your deepest down-brow workings are about 800 yards?—Yes.

15326. Is it a fact, or is it not, that looking forward to the future, coal will have to be worked at a much greater depth than formerly?—Undoubtedly.

15327. Therefore in considering what precautions should be taken, that should be borne in mind?—Certainly; it is very important.

15328. You have had experience, I believe, of collieries in Germany and France, or at least you have visited collieries in Germany and in France?—I have.

15329. Have you noticed any difference in the conditions prevailing in the mines there to those that prevail in such mines as you are working?—Yes; there are mines that are exempted from watering which are more dusty than any I have observed here.

15330. What are the conditions of exemption; why are those mines exempted?—On account of the same conditions of the strata that we have here—that it will not stand watering.

15331. If your mine was in Germany would that be exempted?—Certainly it would.

15332. Then is it worse than you have seen in German mines which have been exempted, so far as watering is concerned; would the consequences of watering be more serious than in some of the German mines which you have seen exempted?—I do not think so.

15333. You think about the same?—Just about the same, I should say.

15334. Is your mine at all typical of other mines in the district in Yorkshire?—Yes, it is a typical mine of all these that are producing the 20,000,000 tons which I mention—the greater portion of them.

15335. Therefore supposing that the mines were in Germany the whole district would be exempted?—Practically.

15336. Have you formed an opinion as to whether dust alone will cause an explosion, or whether there must be some quantity of gas with it?—I think you will get some valuable evidence upon that from Mr. Rhodes, who is going to give you evidence later upon that question, because I know that he conducted some very elaborate experiments with the late Mr. Warrington Smythe, and I myself have made no experiment with coal dust.

15337. I will go back to the question of Germany for the moment; in the mines in Germany, which you say are similar to yours so far as regards being dry and dusty, where they are exempted from watering, what special precautions are taken against the danger of dust?—They try to remove the dust as far as possible, and they take the precautions which I am advocating now; the abolition, as far as possible, of all naked lights, and the doing away with shot-firing, except where it is absolutely safe to fire shots, although they do fire them in some of those exempted mines in the working of the coal and ripping of the roads.

15338. I think the German system merely provides in the general law for the exemption of certain mines?—Yes.

15339. Do you know whether, when those mines are exempted, they are exempted subject to certain other conditions that must be complied with?—No, I am afraid I do not know. I only know from my observations that certain dry and dusty mines are exempted, and that it is on account of the difficulty of watering and liability of causing roads to fall in by watering; that is all I know.

15340. I see in the German regulation "In cases where there is reason to believe that watering would so

Digitized by Google

Mr. W. H. Chambers.

7 Mar. 1907.

disturb the surrounding strata as to considerably increase the danger from falls of stone or coal the watering may be omitted with the special consent of the Mining Board" ? —Yes.

15341. You do not know whether that consent is given subject to conditions ?—No, I do not know. I only know they are not doing it.

15342. They do not water ?—That is so—under those conditions.

15343. (*Dr. Haldane.*) Are you referring to Westphalian mines ?—Yes, Westphalian mines.

15344. (*Mr. Ratcliffe Ellis.*) When you were there did you go down any dry and dusty mine which had been exempted ?—Yes.

15345. Then did you see what they were doing with the dust ?—Yes, I saw that they were sweeping up and removing some dust.

15346. Had they any zones, or were they removing the dust from the ordinary road ?—I did not observe with regard to anything of that kind.

15347. With reference to your own mines, you have some tracings here, I believe, showing the actual effect of watering those mines ?—No, I have not any tracings showing that. The drawings I have submitted show how the roof subsides and closes up after the working. Although there is 7, 8, or 9 ft. of the coal seam abstracted, the roof, notwithstanding the packed wall supports on the roadways, closes and the packed walls are buried and the roof comes down and touches the floor within 40 yards of the face.

15348. Do you mind showing the Commission those tracings which you have ?—I have handed them to the Chairman.

15349. They show the natural condition ?—Yes, that is the natural condition.

15350. When you have got the coal out it begins to come down directly ?—It does. The way in which the height is made is this : it does not require anything as a rule to fetch it down ; it is no use trying to confine the roadways in this seam ; it resents all control ; you cannot put bars or timber supports. The best way to maintain the road, and the way in which it stands best, is to let it arch itself over naturally ; it gradually falls in that condition, and the men who have to go down to keep the road repaired have simply to fill it away. But where it is a little harder it soon comes down if they put a can or two of water upon it.

15351. As you have already said, to water mines of this class is an impossibility ?—Yes ; it would close the roadways up directly.

15352. Therefore some other remedy would have to be found there to guard against the danger from dust ?—That is so ; and that we have adopted as far as we can.

15353. Do you think you could sufficiently sweep or clear away the dust from an ordinary road so as to provide that what dust you could not get away would not be dangerous if left there ?—I could not say that, because the sides and the roadways are so rough that you could not possibly sweep it all off.

15354. But whether what was left, if you swept as much as you could, would be dangerous or not, you cannot say—that requires finding out ?—That requires finding out, certainly.

15355. With reference to the dust that goes down the down-cast shaft, do you think that is serious in quantity ? —Yes. I may say that we ourselves collect over a ton per day from two screens, and that does not represent all that is made on the pit hill. We are extending the method of collecting it as fast as we possibly can to catch it all.

15356. Is it a profitable commodity that you collect ?—Well, it may be. For some of it we get a very good price, and for others we do not get very much. It depends upon what sort of market we have.

15357. With regard to the cost of the apparatus by which you collect it, is it remunerative ?—No, I do not think it is.

15358. If it gets down the pit you think attempts ought to be made to minimise the quantity that is deposited in the pit as much as possible ?—I do.

15359. As much as possible should be kept from going down the pit ?—After you have once got it out you ought to keep it out.

15360. Then your tubs and other things may be so constructed as to make the deposit of dust as small as possible ? —I think so.

15361. Do you think there could be any rule established by which it should be obligatory, as far as practicable, to keep dust from accumulating—a General Rule leaving it to the management as to how it should be done ?—As you put it, as far as practicable, I think so.

15362. Do you think that if there was a rule of that description, as far as reasonably practicable (which is what is provided at the beginning of the General Rules), it would encourage attempts to be made to minimise the quantity of dust that would be made ?—I think it would have a very good effect.

15363. You think it would not be embarrassing in the end, but that by directing the attention of managers to it it would have a tendency to minimise the quantity of dust ?—I think so.

15364. And you think that would be an improvement upon the present state of things ?—A very great improvement.

15365. Now, getting the accumulation of dust into as small a quantity as possible, you desire to do something to prevent the initial cause of an explosion ?—Yes.

15366. What is the danger ? You find shot-firing, of course, is a danger ?—With regard to the ignition of coal dust mixed with a certain quantity of gas, which I think is necessary to cause the dust to be explosive, I think you should take away all possible means of igniting that mixture, either by shot-firing, naked lights, electric contacts or anything else.

15367. I was going to ask you about those three causes. First of all, with reference to shot-firing, do you fire shots at the face in your colliery ?—No.

15368. You do not fire shots at all at the face ?—With a roof of the character that ours is it is not necessary to fire a shot anywhere ; it is only in stone drifts where we use explosives at all, where there is neither gas nor dust.

15369. In mines, generally, where shot-firing is at the face, do you think that the regulations as to shot-firing now as contained in the Mines Regulation Act, in your Special Rules, and in the Explosives Orders, are sufficient to secure safety if observed ?—I do ; because I am not aware of any shot-firing at all in the getting of the coal except in the shallow and safe mines, such as the Shafton seam, which is worked perhaps 100 yards deep and is worked with naked lights because there is no gas.

15370. You do not think there is very much danger in shot-firing at the face if the present regulations are complied with ?—I do not.

15371. But have you anything to suggest with reference to any additional regulations with regard to shot-firing in the haulage roads ?—That they should be fired when the men are out of the mine between shifts.

15372. First of all it has been suggested that they should not be fired at all except with the express permission of the manager, who should prescribe the conditions under which they should be fired ?—Yes.

15373. That is not provided for now. Do you think that ought to be provided for ?—I think it is desirable that it should be so in the roadways.

15374. Would you in all cases consider it necessary that the men should be out of the mine and that the shot should be fired between shifts ?—As much as possible. I think it is very desirable, if it does not materially interfere with the proper working of the mine, all shots should be fired when there are as few as possible men in the mine.

15375. That is in roadways ?—Yes.

15376. It has been suggested to the Commission also that it is desirable that one shot only should be fired at a time, and that a sufficient time should elapse before another shot is fired in order to see that not only there is no gas, but that there is no dangerous dust about ?—That is desirable too.

15377. You think that would be desirable ?—I should adopt that if I had it to do.

15378. So that the provisions requiring that there should be an examination to see that there is no gas should also include the requirement to see that there is no dust that will be dangerous ?—That is so.

15379. And that would be an advantage ?—Where there is watering now done in the neighbourhood of a shot, you see there rather follows what I observed before with regard to the dust-laden atmosphere. Shot-firing, although there

Digitized by Google

would not be sufficient in the air to propagate an explosion, if there was another following it close after, when all the dust was floating about in the air, would be dangerous. Sufficient time should be allowed to elapse, I think, to let that subside.

15380. You think that ought to be made a requirement, too ?—Yes, I think so.

15381. Another thing is the use of naked lights in mines. At present the Act requires that safety lamps should be used where gas is likely to be present in such quantity as to be dangerous. The provision is: "No lamp or light other than a locked safety lamp shall be allowed or used (*a*) in any place in a mine in which there is likely to be any such quantity of inflammable gas as to render the use of naked lights dangerous." Now there is the question of opinion as to what is such a quantity as to render the use of naked lights dangerous, and that is a matter upon which people might differ ?—Yes.

15382. Do you think that ought to be strengthened at all ?—I think, as I observed in answer to one of the Members of the Commission, certain seams are known to be gaseous, and the conditions are known to be such as to have caused cautious owners to adopt the use of safety lamps. I think where those conditions are known to be generally dangerous you ought not to wait until there is an explosion before providing that these precautions should be generally adopted with regard to working that particular coal. It is generally known in all districts which are the dangerous seams, and I think the same Rule ought to apply to all.

15383. I do not quite gather what the Rule ought to be. Would you provide that with regard to a certain seam, even if there had been no gas at all seen in it, safety lamps should be used ?—Well, down to certain depths. At the outcrop they might not be gaseous seams, but where the mine gets deeper they might be.

15384. You think that Rule ought to be further considered ?—I think it should be.

15385. Next with reference to electricity; do you think that the Rules as to electricity are sufficient now for safety ?—I do, if the owners will only interpret them in the spirit as well as the letter in which they are drawn.

15386. The danger, I believe, is the cable, is it not ?—Yes; and I may tell you that in our case what we do with our cables is this: they are put in boxes and covered over with steel lids and buried not less than 2 ft. in the floor, so that they cannot be injured. That is the precaution which we take; but it is not possible to do that everywhere, of course.

15387. In mines where you cannot water and in mines where you cannot clean, if it be decided that you cannot clean sufficiently, and the construction of zones might be very expensive in regard to masonry and things like that, and in cases where you have to rely for safety upon these regulations with regard to shot-firing and electricity, is there any Rule which you would suggest in addition to the Electricity Rules as being necessary to provide for safety ?—No.

15388. You say that you cover your cables ?—Yes.

15389. Now that is not provided for in the Electricity Rules ?—It is not.

15390. Do you think there should be some provision as to that ?—No, because the conditions would not be favourable to it in every mine, and I think the conditions of a mine should regulate to a great extent what is necessary to be observed in that mine. You cannot make the same Rule apply to every mine alike, and you cannot even make the same Rule apply to every district in the same mine.

15391. You have nothing to suggest in addition to the Rule with reference to cables which is already provided in the Electricity Rules ?—I have not.

15392. Do you use coal cutters ?—No.

15393. You know many mines in which they are used ?—I know some places where they are used.

15394. With regard to the motor, do you say it ought to be enclosed ?—The motors are mostly enclosed; all I have seen are enclosed motors.

15395. Then the motor should be enclosed; there should be no unenclosed motor at the face ?—Those which I have seen working in dry and dusty mines are enclosed.

15396. Then so far as you know generally the Electricity Rules, if properly observed, are sufficient to secure safety ?—Yes; and I think they are very good Rules, too.

15397. (*Mr. Smillie.*) I suppose you understand electric coal-cutting machinery ?—I have never used it myself; I have only seen it in operation.

15398. You have seen it operating and you really know the system and the methods of working it ?—Yes. We use electricity exclusively for power in our pits.

15399. With electric coal-cutting machines you are aware there are trailing cables which may require to trail 20 or 30 yards ?—Yes.

15400. It would be impossible to enclose those in steel pipes ?—That is so.

15401. And if the outside covering comes off they may be bare ?—There would be very great risk of short-circuiting, and also, if it lies across a rail and a fall takes place upon it, that will cut the cable and cause short-circuiting, and make a flash.

15402. And there are switches in the roadway where they switch on the current ?—Under the Rules those have to be enclosed.

15403. I think, if your theory is correct—a theory which no other witness, I believe, has put forward—that in a dry and dusty mine there is always suspended sufficient fine dust to carry an explosion, once initiated, then the question of watering or of dry and dustless zones largely falls to the ground ?—That is what I think.

15404. I think you said you collected two tons of dust ?—One ton from two screens; but I may inform you that from two screens at the Mines de Dourges, where they were not putting down nearly so much coal as they were putting down at ours, they collected a ton and-a-half in about half the time.

15405. What time did it take to collect two tons ?—We collected a ton from two screens in about 14 hours. At the Mines de Dourges they collected a ton and-a-half in 10 hours from two screens.

15406. I suppose you could not give the Commission any idea of what proportion of that amount of two tons in your mine might have found its way down the downcast shaft; it would be impossible to give any idea ?—That is so, but I got them to stop the machinery while I was there, and it was as dense as any fog I have seen about the pit top when they were not doing it. I do not think they adopted it to prevent the dust going down the pit in that case, but it was such a nuisance on top that men could not see to do their work.

15407. But it is the case that a considerable amount of dust from the screens finds its way down the mines ?—Undoubtedly; that was the reason, and there was no other reason why I adopted it. I did not find it in operation in any other pit in this country and that is why I went to France to look at it.

15408. (*Chairman.*) Do I understand that the whole of this was fine dust ?—Yes, it was all dust that would float in the air.

15409. There was no small coal in the dust in the two tons as you collected it; it was all absolutely fine dust ?—Yes, altogether fine dust, and it was taken a considerable distance away by air exhaustion.

15410. (*Mr. Smillie.*) The fine coal dust in the air around your screens would be in a larger proportion, probably—there would be more of it suspended than there would be in the ordinary intake air-course in a dry and dusty mine ?—Yes.

15411. Do you think that a blown-out shot or a gun-shot fired into the screen would cause an explosion ?—I do not.

15412. Would it cause an explosion underground if it would not cause an explosion on the surface ?—I do not think so, unless there is something with it; coal dust alone would not do it. Has it ever been proved that it is possible to get an explosion from coal dust alone ?

15413. Do you mean by a blown-out shot ?—Yes.

15414. It is the theory which is held, I think ?—It is the theory, but that requires proof, you see.

15415. This is rather important, I think. Take it for granted for the time being that a blown-out shot could initiate an explosion of coal dust under the conditions which you yourself have put forward, that fine dust was suspended in the air——?—Exactly; I have taken it as a possibility that it may be so.

15416. Then under similar conditions on the surface—a blown-out shot or a gun going off—the flame would initiate an explosion on the surface ?—Well, I should not like to try it.

Digitized by Google

Mr. W. H. Chambers.

7 Mar. 1907.

15417. I suppose there is nothing to prevent it doing so; if it would take place underground there is nothing to prevent it taking place on the surface?—I do not think so.

15418. But up to the present time there has been no favourable circumstance, or, rather, unfavourable circumstance, to prove it?—We have never had an explosion at the pit bank.

15419. But in some cases at the surface in dry and dusty mines where a considerable amount of dust has been raised, there have been very large fires which have given off gas there?—Yes.

15420. And up to the present time there has been no coal dust explosion arising from that cause of coal dust on the surface?—No, nor any other reason except, as I state in my evidence, where it has been accounted for by detonation.

15421. I think you stated to Mr. Abraham that, so far as you know, no serious explosion has taken place in recent years which has arisen from any cause that is not at present provided for?—That is so.

15422. An explosion underground under certain circumstances might take place by a safety lamp being injured suddenly and gas at the same time coming down on the lamp?—It is possible, but it is very highly improbable, because no man is allowed to continue to work in a place, even with a safety lamp, unless it is clear of gas, and the Rule must be broken if the condition of the atmosphere were such that it would even be lit by a lamp which had been injured and not made safe.

15423. Men might be working for the time being under a heavy fall where there was a vacancy which might contain a considerable quantity of gas; a sudden outburst from the bottom of an upper seam might have filled up the space above?—Yes, it is possible.

15424. And a fall of stone or a fall of coal from the top taking place might bring down suddenly a body of gas and injure the lamp at the same time and cause an explosion?—I think under a condition like that the light in the lamp would be extinguished before it could ignite even the gas under those conditions.

15425. I do not know whether you have the evidence given in the Inquiry on the explosion at the McLaren Colliery, South Wales—Abertwssyg?—No.

15426. The theory was put forward that that was what caused the explosion there?—Yes; there are a good many theories, and I do not quite follow them all. Many of the theories are plausible and yet they have not been proved.

15427. In that case there was no open lamp found, but an injured lamp was found?—Yes. There was a theory put forward, but it was only a theory.

15428. Well, an explosion did take place?—Undoubtedly.

15429. And there were no shots fired; that was admitted and proved?—Yes.

15430. Neither were there any naked lights used there?—But they found an injured lamp and they did not know whether that lamp had been injured before the explosion or after, or anything more about it.

15431. That could not be proved?—No.

15432. But it was proved that the explosion, having taken place, had traversed the main intake air course and killed a considerable number of men 400 or 500 yards from the seat of the explosion?—Yes.

15433. Had there been some wet zones or dustless zones between the point of the ignition of the explosion and the pit bottom, do you not think they might have prevented the loss of some life?—I do not know; I should not like to go so far as that. I do not adopt the theory which has been advanced, that one of these lengths of arching would stop the propagation of an explosion in the way that some of the witnesses took it for granted that it would. I think that wants proving.

15434. I think we may take it from you that your evidence is that there is no need for further legislation to deal with this?—No, I would not go as far as that. I only say that there ought to be very great care exercised to see that there is no undue restriction put upon the working of collieries which might result in imposing impossible conditions and which would be paramount to closing the mine as being too dangerous to work.

15435. But if the present conditions are sufficient, if carried out, then there is no occasion for further legislation?—I say it is impossible to carry them out by either zones or general watering in regard to some mines that would have to be exempted; and you must have it in your mind that it will be very necessary in dealing with this matter to have other means where it is impossible to carry out these measures—to see what other precautions can be taken to prevent explosions as well as to minimise the effect of an explosion. I think you will agree that it is better to prevent an explosion rather than to confine it in a certain area.

15436. Quite, but there is really no provision at the present time in any mining legislation for providing dustless zones or wet zones?—No, but there is with regard to having naked lights in a dangerous seam.

15437. Again, I want to put this, because I should like to know clearly what is in your mind. Your opinion is that there is no necessity for further legislation if the legislation at present on the Statute Book—and the Special Rules, of course—were carried out?—I will take for instance, our own case. If it were possible to exercise any further precaution to preserve the safety of the mine and of the men in it we would have adopted it; because I have given you instances where we have been in front of legislation years and years. We would not wait for the law to enforce any of those precautions, but we should adopt them, and other people are adopting precautions which are not compulsory, in the same way as we are doing ourselves.

15438. Are you in front of legislation now?—Undoubtedly we are; we are in front of legislation with regard to collecting the dust that goes down the pit from the pit hill. We are in front with regard to timbering.

15439. If you are in front of legislation does not that prove that further legislation is required, in your opinion?—No, I think the principle which you have acted on hitherto is a reasonable and proper one, that is, to whip up laggards who are behind the general practice.

15440. (*Dr. Haldane.*) I am not quite clear with regard to the mines in Westphalia where you found that there was no watering. Can you tell me what seams you were referring to?—No, I cannot remember the seams, I only saw the conditions. I am not very well acquainted with the German language, and I may say that I went down one pit and spent the whole day there, and although I could not get much information from the people in the pit, I used my eyes and saw the condition of things.

15441. I daresay you know that certain seams there are exempted on the ground that the dust from them is not dangerous?—That I do not know. I saw there was dust, and I know also that the strata was not such that it would stand watering, and I understood that that was the reason they did not water. They removed as much as they could in the same way that we are doing it—brushing it out.

15442. When was that?—Five years ago, I daresay. It must have been about that time that I was down the last mine I saw there, a colliery in the neighbourhood of Wanne.

15443. Was it the Shamrock?—It was not the Shamrock, because it was years before that when I was down the Shamrock.

15444. Perhaps you are referring to the time before the present Regulation came into force. It has only been in force for about five years?—But there were mines being watered at the time.

15445. Yes, mines had been watered in Westphalia by the mineowners themselves for a long time back?—I remember talking to Herr Meyer about it, and he gave me some information with regard to the subject.

15446. I think that may have been before the present general Regulations came into force?—I do not think so, because he visited our collieries and he told me that with regard to the dust even in Westphalia there were great difficulties in dealing with the matter, and they could not adopt a general system at their collieries.

15447. You are pretty well convinced that what you are referring to were not the seams which are exempted on the ground that the dust is not dangerous? There are such seams in Westphalia?—Probably.

15448. But I was told that outside them there is practically no exemption?—I know it is impossible in some of the seams that I saw; they were to a great extent in the same condition as ours, and I do not think it would have been safe to have watered them; neither do I think it would be safe to water in any deep Silkstone pit, or in any Parkgate pit where the clod is on the coal, or in the deep Barnsley pits in South Yorkshire. I say in those places it is impossible to do that general watering. With

Digitized by Google

regard to what may be done by means of zones it is possible to carry that out, but whether it would be effective or not has nothing to do with that question. At the shaft pit bottom we have only sufficient arching to cover such machinery as we have in the pit bottom, and it was put in in about 1894, and it has been in and out many times during the whole of that time; and the men are working on it to-day, and it is not still yet. With regard to the other shaft we have never attempted to arch it up until now, and 30 yards up the shaft it was never lined. We are trying to deal with it now; we are not putting in masonry, but we are trying another system with that part; we are cutting oak logs up and putting them end on, 6 ft. long, in a circle so that, although we know it will crush, we have an idea that it cannot crush it enough to destroy it like it will stonework or brickwork; that is the difficulty we have to contend with in that mine, and others are the same or will be the same.

Mr. W. H. Chambers.
7 Mar. 1907.

Mr. Matthew William Parrington, called and examined.

Mr. M. W. Parrington.

The Witness handed in the following Statement:—

15448A. It is on record that the sinking of the Wearmouth Colliery, of the Wearmouth Colliery Company, was commenced in the year 1826, and coal working began in 1835. The Hylton Colliery was sunk, under my supervision, between 1897 and 1899, in which latter year coal working was commenced. The working coal seams of these collieries lie at a depth of from 1,400 to 1,800 ft. from the surface, and, by reason of their soft and extremely dry nature, an abnormal amount of dust is made in the process of working and in the carriage of the coal from the workings to the surface, as well as in screening and in shipping it at the Company's staiths on the River Wear.

Dealing with the questions put before me, which I will quote:—

(1) *Is any classification of dusty and non-dusty mines possible?*

Yes. There are some mines where the coal seams are actually wet, and where no dust is made either in working or leading the coal, and a great many others (especially in Northumberland), where, owing to the hardness of the coal and a natural dampness, very little dust is made in working and none in leading it.

(2) *What class of dust is explosive, and how is an explosion produced? Can you get an explosion of dust with a naked light only, or must there be firedamp or shot-firing?*

I should say all carbonaceous dust is more or less explosive, whether of coal or other matter, and its explosion depends on the heat to which it is submitted, and on whether there is sufficient air present to support combustion. There can be no doubt of the existence of great variation in the explosive properties of various dusts made in the working of collieries, apparently depending on the conditions to which they have been submitted, such as long exposure to the atmosphere. In my own experience, an explosion of fresh coal dust cannot be got with a naked light only. In the whole process of working and shipping coal at these collieries I put the points at which most fine coal dust exists in suspension in the following order:—

(*a*) In the hold of a ship while taking in cargo.

(*b*) On the screens and cleaning belts.

(*c*) In the face while the coal hewer is working.

(*d*) On the engine planes during the passage of a train of wagons.

The men trimming the cargo in ships' holds work with naked lights, and at times the dust is so dense that the flame of a candle cannot be distinguished 20 ft. away. At Wearmouth Colliery the coals are screened after dark by the light of naked gas burners; there is not only a great deal of dust, but frequently a strong current of air. In the workings and roadways of the collieries Marsaut safety lamps are used exclusively, a large quantity of gas being constantly given off in the workings.

(3) *In what part of a mine is explosive dust found?*

Dust is present more or less in every part of these mines, but whether or not it is under certain conditions explosive there has, happily, been no means of proving. I agree that the most explosive dust is likely to be found on the main haulage roads, where it is frequently stirred up by the trains of wagons running against the intake air current. The least dust is found in the return airways.

(4) *What is the source of this explosive dust?*

The chief sources of dust are:—

(*a*) Blown from the top of full tubs drawn against ventilating current; and

(*b*) Dust from surface—especially screens.

Such dust as is blown from the working faces must travel with the air current towards the return airways; but it settles before arriving in the main returns, very little being found in them. In the Northern coalfield the coal-tubs are generally so constructed that the amount of small coal and dust escaping through crevices in sides or bottoms of full tubs is very small indeed. There are no other sources of dust, and I lay equal stress on the two chief sources, viz., blown from top of full tubs drawn against ventilating current and dust from surface, especially screens.

(5) *How far is it possible to prevent the accumulation of explosive dust?*

"(*a*) *By improving the wagons.*"

I do not think any improvement in the construction of the coal-tubs in use in this district is necessary if ordinary care is taken to keep them in repair.

"(*b*) *By covering the tubs or spraying journeys.*"

A covering to a coal-tub is, to my mind, absolutely impracticable. If the cover was in the form of a hinged lid, there is in most cases not height in the working face to lift it, and a loose cover of any sort would be absolutely dangerous. Spraying the tops of tubs is, of course, possible; but it would be very injurious to the coal, especially the soft coals, which are apt to fall into small when wetted. The value of highly-bituminous coal depends greatly on its freedom from moisture.

"(*c*) *By removing screens or collecting dust by a fan, &c.*"

In most cases it is unnecessary to remove the screens; generally there is sufficient room between them and the top of the downcast shaft to put in a close partition, which, in my opinion, has a much better effect. Collecting dust by means of a fan may, I think, be carried out profitably.

(6) *Assuming that it is not possible to prevent accumulation entirely, the principal method of dealing with it is watering, either* (i.) *complete, or* (ii.) *partial (wet zones).*

(i.) *Do you advocate complete watering, and if so, what system would you recommend?*

I cannot advocate complete watering, because, in the case of the deepest (and driest) collieries, the nature of the strata will not allow of it. We have tried a spraying water tub at these collieries with the result that a movement of the roof and sides was at once set up, causing many falls on the main haulage roads, and the tub had to be withdrawn.

Must the roof and sides as well as the floor be watered, and how often must the process be repeated?

If complete watering was possible, to make it effectual I should say the roof and sides require it just as much as the floor. In these very dry collieries the process would have to be repeated at least every 24 hours.

(ii.) *Would partial watering be equally effective: e.g., by arching and paving certain lengths of road and keeping them watered. What length of watered road would be sufficient to stop an explosion?*

I think partial watering (wet zones), if thoroughly carried out, would be much more effectual in arresting an explosion than complete watering only superficially done. It appears to me that complete watering of the roof, sides and floor can only be superficial, for it is impossible to reach with a jet of water every crevice where dust lodges which would be raised by the force of an explosion. From experience of the effect of a few yards of wet road in stopping an explosion, I should say

Digitized by Google

Mr. M. W. Parrington.

7 Mar. 1907.

that a length of 50 yards, arched, paved and kept thoroughly watered, is quite sufficient.

Can you form any estimate of the cost of effectually watering a mine?

In answering this question I will take the case of Wearmouth colliery, where there is 18¼ miles of haulage road. Watering the whole length could only be carried out by a complete system of pipes with periodical junctions for the attachment of hose pipes. My estimate of the first cost of such a system is £7,400. Then assuming that by means of such a system a man can water a quarter of a mile every day, the annual cost for wages, depreciation and repairs will be £7,230.

If wet zones are adopted, the arching and paving of them will cost £15 a lineal yard and the cost of pipes to carry water to them will depend on their distance from the source of supply, which is generally at the shaft.

Do you anticipate any difficulty arising either from complete or partial watering, e.g., increased danger from falls, danger to health, &c.?

The following is a statement of fatal accidents which have occurred at these collieries in the last 10 years and their causes:—

Crushed by tubs in workings or on horse roads	15
Falls of stone	10
Killed by trains on engine planes ..	2
Machinery	1
Miscellaneous	3
Total underground	31
Surface—Sidings	1
	32

The underground accidents average 1 death in every 301,474 tons of coal drawn and 1 per annum of every 925 persons employed. The accidents by falls of stone would be greatly increased by complete watering, and those caused by tubs in the workings and on horse roads, being largely attributable to sudden movements of the roof, bottom or sides forcing the timber out of position and leaving insufficient space between it and the passing tub, would also be increased. In hot weather the atmosphere deposits its moisture on the roof and sides and at such a time we look for the greatest danger from sudden movements of the stone and falls. I have always attributed the very healthy condition of these mines to their dryness, and I believe to add moisture to the air would prejudice the health of the persons employed in them.

(7) *Have you any observations as to alternative schemes for dealing with dust?*

The main haulage roads at these collieries are swept at frequent intervals, and the refuge holes are kept whitewashed, for the purpose of calling the attention of persons passing to them, but whitewash does not present a surface to which fine dust will not adhere. To arch and pave the whole length of the roads is quite impracticable. Sprinkling common salt has been tried, but the atmosphere is too dry to bring about its deliquescence.

(8) *Generally what recommendations would you make as to practical methods of preventing danger from dust explosions?*

I shall be glad to communicate the precautions adopted at these collieries against such danger and to make some observations on the system adopted in Germany.

The thorough examination of the various dusts and the testing of their explosive properties under different conditions seems essential, and a central laboratory, under the control of the mines inspectors, should be established in each of the coalfields for this purpose.

15449. (*Chairman.*) You are a Member of the Institution of Civil Engineers?—Yes.

15450. I understand that you have been in turn Certificated Manager and Agent at the Collieries of the Wearmouth Coal Company, Limited, since June 1st, 1873?—Yes.

15451. Is that experience in the Wearmouth Coal Company your only experience of coal mining?—Before that I had charge of other collieries; I began in the year 1864 to serve my apprenticeship.

15452. Where?—At the collieries of Messrs. Bell Brothers, Durham.

15453. Then your experience has been entirely in Durham, has it?—For a year and a half I was at the Cleveland Ironstone Mines, principally sinking shafts.

15454. You say your collieries are 1,400 to 1,800 feet from the surface, and are soft and extremely dry?—That is so.

15455. You say that you can classify dusty and non-dusty mines, there being some mines where the coal seams are actually wet and where there is no dust?—That is so.

15456. You say there are a great many other mines, especially in Northumberland, where, owing to the hardness of the coal and the natural dampness, very little dust is made?—Yes.

15457. You mean that by classification you can say very clearly that certain mines are dusty, and that certain mines are not dusty, but I suppose it is difficult to draw the line exactly as to what is a dusty and a non-dusty mine?—There can be no doubt about some mines being dusty.

15458. Then what would you call a non-dusty mine—a mine where there is no dust, or how would you draw the line?—I should call it dusty, I think, if there was any accumulation of dust at all that was likely to be raised by passing trains.

15459. Sufficient accumulation of dust to, in your opinion, render the carrying on of an explosion possible?—Yes.

15460. That would be rather difficult to test, would it not?—I do not think it would be difficult to test.

15461. Do you think, from your own knowledge, that you would be able to say that a certain amount of dust would carry on an explosion, and that a certain amount of dust would not carry it on? Could you form an opinion upon going down a mine, as to whether it was a mine where there was sufficient dust to carry on an explosion or not?—I think very little dust will help an explosion.

15462. That is to say, will carry it on?—To a certain extent, until it met with non-dusty passages.

15463. You put the points at which most fine coal dust exists in suspension in this order: "(*a*) In the hold of a ship while taking in cargo: (*b*) On the screens and cleaning belts: (*c*) In the face while the coal hewer is working: (*d*) On the engine planes during the passage of a train of wagons." I do not know that we have much to do with the condition of the hold of a ship while taking in cargo. As regards the screens and cleaning belts, would you say that the dust on the screens is more inflammable than any other dust?—I cannot say that, because I have tried to inflame the dust on the screens, without success, at a naked flame. I tried that because I knew that on one occasion at a neighbouring colliery a plank which had been some time on the roof above the screens had got tipped up, and the dust that was lying upon it fell upon a gas-jet and did inflame; so I tried our own dust off the screens: I collected the finest possible dust that had been lying there a long time, and I tried to inflame it at a naked light, but I did not succeed.

15464. You say the chief source of the dust is first of all the dust blown from the tops of full tubs drawn against ventilating currents; secondly, dust from the surface, especially screens; and, thirdly, such dust as is blown from the working faces. You mean, I suppose, that the greater quantity of dust that you find in a mine is blown from the tubs?—The greater quantity of dust on the haulage roads is blown from the tops of the tubs, in my experience.

15465. But may it not find its way down the mine from the screens, and get deposited on the haulage roads?—In my experience it does not go far from the shaft bottom.

15466. So that the screen dust is very soon deposited—you would not find that very far in?—No, I think not.

15467. You do not think that dust is blown from the working places. I suppose that would depend almost entirely upon the character of coal you are working?—I do not think that any dust is blown from the working faces. When the air-current is sub-divided at the different working faces it can hardly be called sufficient to blow a cloud of dust. The dust in my experience in the working face settles before it comes into the returns; it settles in the goaf and is embedded there.

15468. So that you do not think there is any great danger from dust in the working faces?—I have thought not.

Digitized by Google

15469. Then you say that very little dust escapes through crevices in sides or bottoms of full tubs. I suppose that is when they are properly made; and you say that your tubs are properly made, and that tubs can be properly made so that very little dust shakes out of them in that way?—Yes.

15470. Nearly the whole of the dust that comes from the tubs comes from the top, in your opinion?—That is so. As a rule the dust blows off the tops. The tubs are so made that very little dust shakes through the crevices—in fact there are no crevices.

15471. How do you prevent crevices being in the tubs?—There are some tubs made of sheet steel, and of course they are absolutely dust-tight; others, really good wooden tubs, are so closely made that the dust cannot come through.

15472. I suppose the sheet steel is by far the best kind of tub?—It is the most dangerous kind I think.

15473. In what way?—In other ways, not with regard to distributing dust. It is a very dangerous tub to work with; it is more apt to crush people.

15474. You mean it is heavier?—It is heavier, and besides, the slightest break in the sheet of steel forms a sharp point.

15475. (*Mr. Ratcliffe Ellis.*) It is like a knife?—Yes.

15476. (*Chairman.*) If there is a break I suppose that means that there is a hole in the tub, so that the dust would get out?—Yes, and then a hole is very soon formed in a sheet of steel, because corrosion is very rapid.

15477. Even if you do not spray the tubs the corrosion is rapid, is it?—It is.

15478. And you say you do not spray the tubs in your part of the world?—We do not spray the tubs.

15479. If they were sprayed the corrosion would be much more rapid?—It would be more rapid still.

15480. So that what you say is that these steel tubs are a mistake, and that what you want is to have good wooden tubs made in such a way that there shall be no crevices, and that you should have wood that does not warp?—That is the course which we have adopted.

15481. You are quite satisfied with your wooden tubs?—We are quite satisfied with them.

15482. You say that it hurts the coal to spray the tubs if the coal is bituminous?—Yes; and soft coals are apt to fall directly, just as the stone falls when damp comes, at such a depth as ours.

15483. With regard to screens, you say that, speaking generally, there is sufficient room between them and the top of the downcast shaft to put in a close partition, which you think is better than removing the screens?—I think so.

15484. What sort of partition would you have?—In the case of our new colliery we have a solid brick wall.

15485. How high would the brick wall be?—From the surface level to the top of the wall I think it is 27 ft.

15486. Is that sufficient to keep the dust from rising, or, rather, does not the dust rise over that 27 ft.?—Yes; then above the wall there is a corrugated iron shed with only openings for the tub to go through.

15487. So that you not only have the wall to prevent the dust going down the shaft but you also have these iron sheds above the wall which keep the dust in?—Yes. The wall is from the surface level to the height of the landing of the cages.

15488. What height do these iron sheds go up to?—About 25 ft. higher.

15489. I suppose very little dust would get above the 25 ft.?—None, because again it is roofed over, and what dust does go there settles on the roof.

15490. Then you say you think that collecting dust by means of a fan may be carried out profitably. Have you tried that system?—I have not tried it, but I think it can be carried out to a commercial profit. I have always thought so, and I have always intended to try it.

15491. Have you seen any system of clearing out the dust by fans?—I have not.

15492. Then you say you cannot advocate complete watering, because in the case of the deepest and driest collieries the nature of the strata will not allow of it. But supposing the collieries are not particularly dry or deep, would you have complete watering in many of the collieries which you know?—Yes, I think you might have complete watering; but in many cases it has very much the same effect as putting water on quicklime.

15493. Do you mean that there would be heaving of the floor?—Movement of the floor, sides and roof.

15494. But are there any collieries where you could have complete watering without any great amount of heaving of the floor and sides?—There may be some.

15495. But is it not the case in yours?—I do not think any of our collieries could.

15496. Your collieries are all dry collieries?—They are dry collieries.

15497. You say that if complete watering was possible, to make it effectual you would think the roof and sides would require it just as much as the floor. You say "just as much as the floor"; is that so? Some witnesses have said that if you wet the floor that has a very considerable effect on stopping the dust all over the mine, because from time to time the dust would be blown off the roof and sides and would settle on the floor and would become damp, and it would settle there and become innocuous, and not be carried on anywhere else?—Well, I think the most dangerous dust is on the sides.

15498. Yes, the most dangerous dust, but some people say that the dangerous dust is considerably diminished in quantity if you only water the floor and not the roof and sides, and that from time to time the ventilating current takes the fine dust away from the roof and sides, and the fine dust in course of time gets deposited on the floor in the ordinary course of things?—Yes, I have no doubt that watering the floor will diminish the quantity of fine dust which is raised by the passing tubs.

15499. You say that if you had a complete system of watering it must be repeated every 24 hours in very dry mines?—That is our experience. We have attempted to water a certain length of road where the stone was of such a nature that we thought it would stand it.

15500. You found it did not stand it?—We found it did not stand it, and we found it was absolutely dry in 24 hours—you could not see where the water had been put on.

15501. You found that not only was there the expense of watering but also the expense of repairing the damage done by the watering?—It was not a question so much of the expense, as of danger. We have a very long system of engine planes, and the stones came down in front of the setts and threw them off the line, and so on.

15502. With regard to zone watering, you think that zone watering would be much better than complete watering if that watering is only superficially done; and you think that a length of 50 yards arched, paved and kept thoroughly watered would be sufficient to stop an explosion?—I think so, from what I have seen.

15503. Upon what do you base that opinion?—From my experience after explosions at neighbouring collieries.

15504. You say you have noticed that a well-watered zone of 50 yards has been sufficient to stop the explosion?—I think so, from what I have seen at Usworth, Seaham, and other places.

15505. Then you proceed to give an estimate of the cost of watering. You take the Wearmouth Colliery, where there is 18½ miles of haulage road, and you give an estimate of the first cost of a system of watering—I suppose that is a system of complete watering?—A system of complete watering.

15506. Not general watering?—Yes, laying pipes the whole length.

15507. Your estimate for the first cost of that is £7,400; that is simply the cost of laying the pipes. That cost would be the same whether you do zone watering or complete watering, probably?—No, not unless you had each zone absolutely at the far end of each road.

15508. Exactly; you mean that you might have pipes laid part of the way as far as the zone went, and that then the remainder of it would be dry?—Yes.

15509. Supposing you had what you would consider fairly efficient zone watering, how much difference would that make in the length of piping?—I think it would save about a third of the cost.

15510. Therefore you would say that your zone watering would cost something like £5,000 instead of £7,400?—No, it would save more than that, because you would not need such large pipes, to begin with, you would not need so much water, and therefore you would not need such large pipes next the shaft. I think it would probably save quite half.

15511. That is to say that something less than £4,000 would probably be the initial cost for zone watering the whole 18½ miles of the Wearmouth Colliery. Then you think the annual cost would be something over £7,000;

Digitized by Google

Mr. M. W. Parrington.

7 Mar. 1907.

but that, of course, is the annual cost of complete watering?—The annual cost of complete watering.

15512. A fairly efficient system of zone watering, I suppose, would cost a great deal less than that to keep up; there would be so many less men employed?—Yes.

15513. And the depreciation and repairs would probably, be less?—Yes.

15514. So that I suppose you might say that you could set up a system of zone watering for something like £4,000 or less, and that the cost of keeping it up would be perhaps about another £4,000, would you say—something like half what you calculate for the complete system of watering?—Hardly as much as that, because I have in my mind that it would take something like 15 zones in the case of the Wearmouth Colliery, and I think a man would water two or three of those in his shift.

15515. Then you say there is also the cost of £15 per lineal yard for arching and paving. That is not included, I suppose, in the first estimate of cost, is it?—No, that is not included. The complete watering is on the supposition that it is possible to water the roads without arching.

15516. In the Wearmouth Colliery you could do that, could you?—No, we could not.

15517. Therefore in that particular colliery, if you had a zone system, you would have to arch and pave at a cost of £15 per lineal yard?—Yes.

15518. You say 15 zones of 50 yards each?—Yes.

15519. The first cost of that would be how much?—About £750 for each zone.

15520. Then for the 15 zones it would be about £12,000 as the first cost of arching and paving these wet zones?—£11,000.

15521. Then the whole cost would be something like £15,000 to begin with, and, say, £2,000 or £3,000 to keep up?—Yes, I think so.

15522. Something of that sort for the whole 18½ miles?—Yes.

(*Mr. Ratcliffe Ellis.*) How much would that be as a capitalised sum—the £3,000 for keeping it up?

15523. (*Chairman.*) How many years would the Wearmouth Colliery last?—My last estimate was 40 years, I think.

15524. (*Mr. Ratcliffe Ellis.*) That is during the time that these zones would be useful?—Yes.

15525. The £3,000 you put down for keeping them up is the annual cost of repair. Can you give us a capitalised sum to represent what it will cost during those 40 years to keep those zones intact?—I think if I formed zones I would arch them in such a way that they would practically require no repair for the zone itself. The pipes would require repair.

15526. (*Chairman.*) You thought it would cost between £2,000 and £3,000 a year?—Yes, considerably less than half the cost of complete watering. I should think £3,000 would cover it.

15527. Therefore you would say it would cost about £15,000 to set up, and something like £3,000 a year ever afterwards to keep up?—Yes.

15528. You go on to speak about the health of the miners, and you say you have always attributed the very healthy condition of the miners in these mines to their dryness. What makes you say that; have you had any experience of wet mines, and of the health of miners in wet mines?—No, I have had no experience of wet mines; happily our own mines are very dry, but our own men are extremely healthy, I think.

15529. Your own men are extremely healthy, but do you think that they are healthier than men in other mines which are wet, which you know of or have heard about?—Well, I should almost say they are. We hardly know such a thing as consumption or anything of the sort amongst our men. They look much healthier, I always think, than men who are working in wet mines.

15530. In some mines that are very dry surely it is the practice to water to some extent, not so much for safety as for comfort and for the health of the men?—I think if we watered our mines they would be very oppressive. You see the natural temperature at our depth is 90 deg.; that is overcome by the ventilation to an extent; in our working faces it is something like 74 deg.

15531. I should have thought that very dry and very dusty mines would be all the better for being a little moistened. Surely the dry dust gets down people's throats and hurts them?—But it does not do any harm.

15532. You are of opinion that even if you had a slight watering that would do harm, and that the drier the mine is, even although it is very dusty, the more healthy it is?—I might put myself as an illustration. I was down Wearmouth Colliery nearly every day for almost 20 years, and I can only say that for 12 hours after being down my experience was that when one expectorated there were black streaks in it, and yet I suffered no harm, and I do not know that the men have.

15533. Do you know what the death-rate is among your miners?—I do not know the death-rate from natural causes, but by far the dustiest work is trimming in a ship, and our foreman trimmer has been at that work for 42 years, and he is a man of perfect physique.

15534–5. He might be absolutely dust-proof, of course; there may be such people?—He may wet the dust, but he does not add anything to the water; he is a staunch teetotaler.

15536. Perhaps that is the reason; teetotalism may have made him so healthy. Is it your opinion that these dry mines, although they are dusty, have no deleterious effect upon the miners who work in them, and that it would do no good, from the point of view of health, but would probably do harm to introduce any water at all?—To introduce moisture into the atmosphere would make it oppressive.

15537. Even a moderate quantity of moisture would be bad, you think?—I think so.

15538. You say you will be glad to communicate the precautions adopted at your collieries against danger from dust explosions, and also to make some observations on the system adopted in Germany. We shall be glad to hear what you have to say on that subject?—Might I draw your attention to the fact that before I deal with that I have given the number of deaths from fatal accidents, because I think that watering would largely increase the numbers of those deaths.

15539. That I understand; we have had that stated by various witnesses?—Both the large items would, I think, be largely increased by watering.

15540. Yes, so I understand. What are the precautions which you wish to speak about to the Commission, and what observations do you wish to make on the system adopted in Germany?—I can only say that I should very much like to adopt the same system if it were possible.

15541. The system of complete watering which is adopted in Germany?—Yes, if it were possible.

15542. You mean that if the strata were such as to stand watering you would like to have watering?—Yes; and if it did not cause disease amongst the men, or tend to do so.

15543. Then you are of opinion that, quite irrespective of expense—I do not know whether expense enters into your calculation—where the strata are of such a character as to render watering practicable without any risk of falls of roofs and sides, it ought to be adopted, and adopted not in zones, but completely?—I think so, where it is necessary.

15544. Well, that is rather begging the question, I think, to say "where it is necessary." I thought your view was that where a mine was dry and dusty, and fiery, and where the ground was such that you were not afraid of increasing the number of accidents from falls of roof and sides, you considered that it would be desirable to have not only a zone system of watering but probably a complete system of watering?—Yes, it might be desirable; but I think the zone system would be equally effective.

15545. So that even where the character of the mine is such that there is no danger from falls of roof and sides if you thoroughly water, still, instead of thorough watering, you think it would be quite enough if you had zone watering?—I think it would be quite as effective, if not more so; because, as I told you, we tried to water, and we found not only that it would be impossible, from the point of view of making the stone give way, but we found it impossible to get into every crevice with a jet of water where there was dust lying which would be perhaps crusted over when it dried up again, but would certainly be raised by the force of an explosion.

15546. Therefore you prefer to specially prepare certain zones so that you could be quite certain that those zones should be thoroughly wetted and would contain no dry dust?—That is my opinion.

15547. But I suppose in some mines the strata would be of such a nature that that would be unnecessary: the

Digitized by Google

seam might lie almost entirely in stone, might it not?—But some stone will not stand watering. It is quite a common practice for our stone-men, if they have a bit of stone to take off the side, to pour water on it the night before, and they expect to find it cracked to pieces the next day.

15548. At all events, you prefer the zone system under all circumstances, apparently, to compiete watering, whatever the mine may be like?—I do.

15549. Then you say you wish to make some observations with regard to the system adopted in Germany. That is, I suppose, the complete watering system?—Yes. I have read about it carefully; my only observation is that the strata must be very different; the sides and roofs of the haulage roads must be very different from ours, or it could not be carried out.

15550. But you have no personal experience of the system as it is carried out in Germany?—I have not any personal experience of it.

15551. There are exemptions, as you perhaps may know, from this watering in Germany. In the last paragraph of your Statement you suggest that a Central Laboratory, under the control of the Mines Inspectors, should be established in each of the coalfields for the purpose of a thorough examination of the various dusts and the testing of their explosive properties under different conditions. Is not that rather a large order, that a Central Laboratory should be established in each of the coalfields? There would be about half-a-dozen coalfields?—Yes.

15552-3. Therefore, there would be about half-a-dozen different laboratories in which experiments would be constantly going on. That is your idea, I suppose?—That is my idea. I do not think it would be very expensive.

15554. (*Mr. Wm. Abraham.*) Do you consider that your mines are very deep mines?—No, not now, as deep mines go. At one time Wearmouth Colliery was the deepest in the world; but that, of course, was in the year 1835.

15555. There are much deeper mines at work now?—Yes, many.

15556. What is the general character of the strata in your mine?—It is a blue shale, generally.

15557. The common blue shale?—I do not know whether you would call it common blue shale; it is blue shale of a very friable nature, and when it comes to the surface we make bricks of it.

15558. Have you had any experience of watering at all beyond using that tub, or whatever you call it?—Do you mean the spraying tub?

15559. Yes; have you had any experience of watering beyond that?—In our own collieries?

15560. Yes?—Yes; we have a small system of pipes to our stables, and we have tried putting a branch on to one of those and watering with it.

15561. Have you tried that on your travelling roads?—Yes. I mean on the travelling roads; these pipes go along the travelling roads to take sufficient water to the ponies, not very far from the shaft.

15562. Then really you have had no experience on the bulk of your travelling roads with any kind of watering but this spraying tub?—No, we have not tried general watering except by the spraying tub. But in the summer, when the atmosphere gets warmer than the sides of the roads, it deposits its moisture on the sides, and then we have the stone giving way; we look for falls then more than at any other time.

15563. Does the atmosphere above affect the working parts of your mine?—When it gets hotter than the sides of the mine itself it does. Something like 250,000 cubic feet per minute of the atmosphere is travelling through our mine, and when it gets warmer than the sides of the mine itself it deposits its moisture on the sides, and that affects the stone the whole way.

15564. Have you had any experience in your collieries of any falls occurring as the result of artificial watering?—Yes; when we tried the experiment we had considerable quantities of stone fall.

15565. What experiment do you refer to?—The experiment with the spraying-tub that I mentioned. Considerable quantities of stone fell along our engine planes, and that made it highly dangerous.

15566. Are your travelling roads timbered?—Yes, partly timbered, and in some places where the stone is very bad, they are arched, but not for any great length.

15567. Where did this fall of stone take place?—Where the timbering was—between the timber.

15568. Did you have men killed from falls of stone where the travelling roads were timbered?—Do you mean through the watering?

15569. Yes.—No, luckily we had nobody killed, but they might have been killed if they had been there when the stone fell.

15570. With regard to the number of men killed by falls of stone, you are not able to say that the number of deaths are caused by watering?—I am not. But we have more falls in the summer-time, when, as I have said, the atmosphere deposits its moisture, than at any other time; and there are more accidents from falls then.

15571. Are you justified in attributing them to the atmosphere?—Most certainly. It is pretty well known to all our officials and men that in hot weather they must be much more careful in examining the roof than at any other time.

15572. That is at the depth at which you work?—Yes, certainly. 250,000 cubic feet of air per minute is travelling through the mine. It comes from the surface, you understand.

15573. In the summer-time the atmosphere is rather more dry than it would be if the weather were wet, is it not?—No, that is not so.

15574. Then does the heat of the sun cause any humidity or dampness?—I should think it does; but still you have extremely hot days occasionally without there being any sunshine, in our summer, which is not very long in the North.

15575. That increase of heat would not be any danger to you?—There is the danger that I speak of, from increase of heat in the atmosphere—the atmosphere then deposits its moisture.

15576. Then it is not the increase of dampness?—No, I do not think that there is an increase of dampness.

15577. (*Sir Lindsay Wood.*) I think in all the deep collieries, there are considerably more falls of stone in the wagon-ways during the summer months than during any other period of the year?—That is so; that is a well-known fact.

15578. It is not confined to your colliery alone?—It is not confined to our colliery alone, certainly. Perhaps I should have explained to the Chairman at first that my experience is not confined to our own collieries; I have considerable practice outside them. I think I have been down nearly every colliery in the county of Durham and a good many in Northumberland.

15579. I thought you were rather referring to your colliery alone when you spoke of the falls of stone during the summer months, but that is common to all the collieries in that district?—It is common to almost all the collieries; in fact, I should say that in the shallower and cooler collieries the effect is longer, because you do not necessarily have to have the temperature so hot when it begins to deposit its moisture.

15580. You said you considered you would have to have 15 zones in your collieries if zones had to be placed in collieries?—That is so. I am estimating one zone for each branch road.

15581. Supposing an explosion occurred in any one of those branches, would that zone stop it from going into any other district?—From my experience I think it would, if it was kept thoroughly wetted.

15582. Then would not those zones have to be carried forward as the mine extended, further away from the shaft?—Well, in our case, we are as far as we can get, I think, but in a new colliery no doubt they would.

15583. You give the number of deaths for 10 years in your colliery?—Yes.

15584. There is no account of any death from explosion in your statement?—No; I am happy to say there is not.

15585. There have not been any explosions for 10 years at any rate?—There has not been any explosion at all during the life of the colliery, I am happy to say.

15586. And that is a very long time?—72 years.

15587. The expenditure of £10,000 and £3,000 a year would not improve your colliery so far as the death-rate from explosions is concerned?—No, it could not do that, because there have been none.

(*Chairman.*) You do not know what the future may bring forth.

15588. (*Sir Lindsay Wood.*) Well, it is not likely. You have gas in your colliery?—Yes, a very large quantity.

15589. Then do you fire shots?—We do not have any

Digitized by Google

Mr. M. W. Parrington.

7 Mar. 1907.

need to fire shots in the face, and we do not fire shots on the main haulage roads.

15590. Do you attribute your freedom from explosions to those causes?—I cannot say that, because it was quite a common practice at one time to fire shots.

15591. (*Chairman.*) Where?—At Wearmouth colliery.

15592. In the face or in the haulage roads, or where?—Both; in fact, in my time, after the 1872 Act came into operation, the whole of the refuge holes on the main haulage roads had to be excavated, and of course they had to be completed in a certain time, and therefore it was absolutely necessary for their completion to fire shots to excavate.

15593. (*Sir Lindsay Wood.*) But you had no accident from that?—We had no accident from that.

15594. Did you water at that time?—No, we did not water at all.

15595. (*Chairman.*) Not for shot-firing?—Not even for shot-firing.

15596. (*Sir Lindsay Wood.*) On the main wagon-way?—I am bound to say we knew very little about coal dust.

15597. It was just then that the coal dust question began to come into knowledge, was it not?—Hardly. I am speaking of 1872.

15598. I think it was about 1865 that the effect of coal dust was first observed. In advocating the German system, do I understand you to mean that there should be a law passed that all mines should be watered, and permission given for exceptions?—No, I did not mean that at all, because I do not think it is necessary to water all mines. I think from what I have seen that zones properly made and kept wet would be better than complete watering. I believe I gave an answer which was not very clear, to the Chairman's question: I did not mean that I would adopt complete watering.

15599. I was simply endeavouring to get your exact meaning?—I meant that I would not hesitate to go to any cost if it was in order to save life, and if it was possible to carry it out. That was really my meaning.

15600. (*Mr. Ratcliffe Ellis.*) How long is it since you adopted this means of preventing coal dust going down the pit?—We have at Wearmouth colliery, the old colliery, a corrugated sheet partition; that was put in somewhere about the year 1880, I think.

15601. Have you observed whether these precautions have lessened the quantity of dust which has accumulated down the pit?—They have, very considerably.

15602. With reference to your tubs, they are constructed in such a way as to make the quantity of dust shed from them as small as possible?—That is so. I think our men would very soon complain if our tubs leaked so as to let any of their coal out before they came to the surface.

15603. Is there any other method which you can suggest that might prevent an accumulation of dust? You see you prevent as far as possible the dust going down the pit, and you take means down the pit to prevent the accumulation of dust from the tubs. Is there any other method which you can suggest?—We sweep our roads.

15604. I am not speaking about sweeping for the moment, but I am referring to preventing the dust accumulating there; there is nothing else except preventing it being shed from the tubs and keeping it from going down the pit?—I think that the passage of one train of tubs along our engine roads is sufficient to deposit a good deal of dust.

15605. But how often do you sweep?—We keep on sweeping; we always have a certain number of men sweeping. I should not like to say how often each yard of road is swept: it depends upon whether the dust accumulates much there.

15606. You do the best you can to prevent the accumulation of dust by preventing it going down, by having your tubs rightly constructed, and by sweeping and removing the dust from time to time?—We are constantly doing that.

15607. Do you consider that the accumulation of dust is a dangerous factor in connection with the working of coal?—No, I think not, if proper care is taken.

15608. But you do take proper care, probably. What I want to know is this: do you think it would be in the interests of safety if there was some general provision made that all practical means must be taken to prevent the accumulation of dust?—Yes, and I should certainly do that; it is much more pleasant, for one thing.

15609. You do that at your colliery?—Yes.

15610. Do you find it very expensive?—I should think we are spending now possibly £700 of £800 a year on men who are cleaning up on the engine-roads and doing nothing else.

15611. May I ask what the output of your colliery is?—About 800,000 tons a year from the Wearmouth colliery.

15612. And it costs you the amount of £700 or £800 a year to keep these roads as clear as you do keep them?—Yes; you cannot walk in and raise a cloud of dust with your feet.

15613. Do you think it is necessary for the safety of your mine that you should take these precautions to keep it as clear of dust as you can?—Well, one's experience does not go to shew that, because at one time one did walk in into two or three inches of dust and raise it at every step.

15614. You could not do watering at your colliery?—We cannot water.

15615. You do not practically do any shot-firing?—We have very little shot-firing; it is not necessary; our coal is soft. At one time shots were fired, because the whole of our output was for household purposes and the coal was undercut with the view to taking the surfeit of gas out of it, and then firing shots so as to get the largest possible amount of round coal.

15616. In the other collieries of which you have experience, is there much shot-firing?—In a good many of them.

15617. Have you any additions to suggest to the present regulations as to shot-firing, in the interests of safety?—No; I think the regulations are very good and very stringent, if they are carried out.

Digitized by Google

Digitized by Google

Mr. M. W. Parrington.

7 Mar. 1907.

need to fi
the main l

15590. to those c a common

15591. (

15592. l —Both ; i operation, haulage ro to be com absolutely excavate.

15593. (from that

15594. I water at al

15595. (shot-firing.

15596. (—I am bou

15597. I began to I am speak

15598. I dust was fi tem, do I a law pass mission giv at all, beca mines. I t made and watering. very clear, that I wou

15599. I meaning ?— cost if it w to carry it o

15600. (adopted thi pit ?—We l a corrugate about the y

15601. H have lessene down the pi

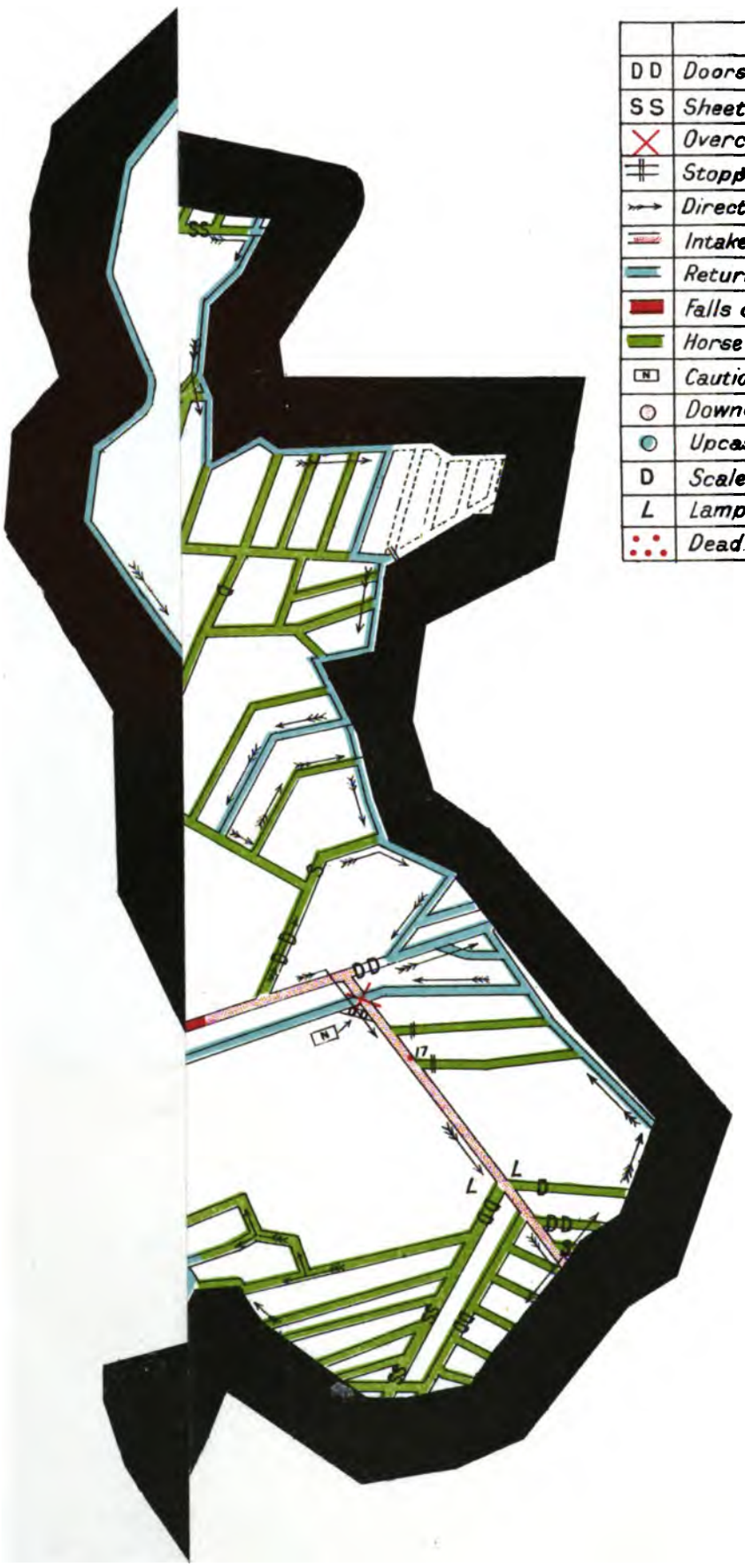
15602. W in such a w them as sm would very any of their

15603. Is that might you prevent pit, and yo accumulatio method whi

Pit Explosion 2nd October 1886.

Coal Face and Working Places;

Haulage Roads, with Falls of Roof.



	Reference
DD	Doors
SS	Sheets
	Overcast
	Stopping
	Direction of Wind
	Intake
	Return
	Falls of Roof
	Horse Roads
N	Caution Board
	Downcast
	Upcast
D	Scale
L	Lamp Station
	Dead

Digitized by Google

Weller & Graham, Ltd Litho. London.

601. 6.07.

Digitized by Google

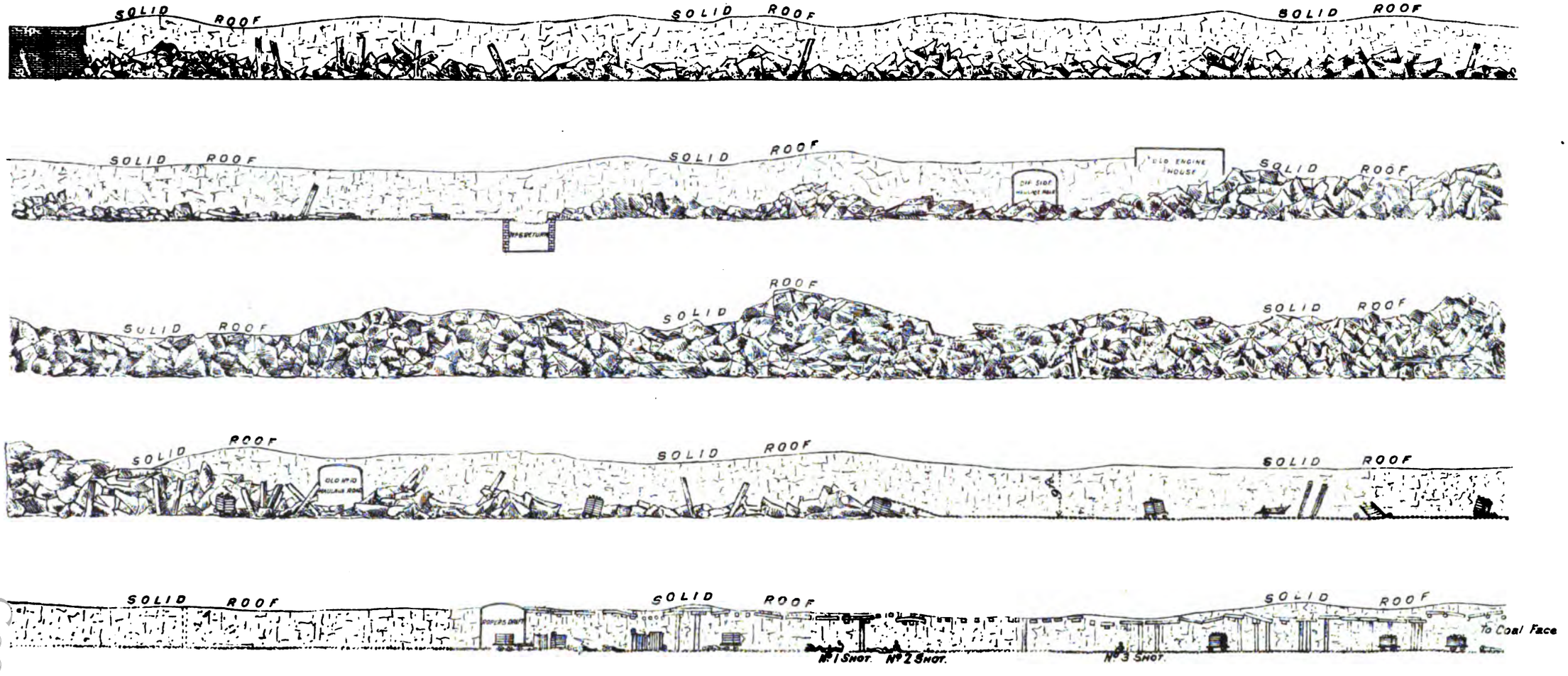
To illustrate Mr W.E. Garforth's evidence.

ALTOFTS COLLIERY.

SILKSTONE PIT EXPLOSION.

LONGITUDINAL SECTION OF WEST CHAIN ROAD.

SHOWING POSITION OF SHOTS Nos 1, 2, AND 3. FALLS OF ROOF, BROKEN TIMBER DAMAGE TO HAULAGE &c



NOTE :- The above was sketched in position during the exploration before the roadway was restored.

Plate XIII.

Weller & Graham, Ltd Litho. London.

Digitized by Google

TWENTY-FOURTH DAY.

Wednesday, 20th March, 1907.

PRESENT:

LORD MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
H. H. S. CUNYNGHAME, Esq., C.B.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. WILLIAM EDWARD GARFORTH, called and examined.

Mr. W. E. Garforth.
20 Mar. 1907.

STATEMENT OF WITNESS.

15617A. A serious explosion took place at the Silkstone Pit connected with Messrs. Pope & Pearson's Altofts Collieries, on the 2nd of October, 1886, which is known as the "Altofts explosion." The verdict of the coroner's jury, as to the cause of the explosion, was "That the whole of the workmen killed (except Deakin and Lomax) met their deaths from an explosion of coal dust which originated in the west chain road, and was caused by the firing of an unskilfully drilled shot by one of the men engaged in widening the road, and that Deakin and Lomax were suffocated by the stoppage of the ventilation consequent on the explosion."

Witness will produce a large cartoon plan and longitudinal section which show the main haulage and intake air roads, also the return airways—position of the two main pits—the situation of the longwall coal face and 800 acres of abandoned workings or goaf—the places where Nos. 1, 2 and 3 shots were fired, the 1st of which caused the explosion—the exact position of the falls of roof—and where the bodies of the victims were discovered, &c., &c.* Such information will be supplemented by a statement giving the depth and thickness of the seam, the extent of the workings, the condition of the roadways, the precautions which have since been taken to avoid a similar accident, &c. It is expected that the Chairman and Commissioners, with such information before them, will, by means of cross-examination, elicit such further information as will enable them to form an opinion as to the cause of the Altofts explosion and the loss of 22 men. As regards the "Weg" Life Saving Apparatus, it is proposed, with the help of two officials, to exhibit the apparatus charged with oxygen, &c., ready for exploration work. The Commissioners by seeing the apparatus will, it is thought, be able to form a much better idea of the usefulness which is claimed for it when explorers are working in irrespirable gases than they would by a written description. If agreeable to the Commission, it is also proposed to exhibit a plan and section showing how working seams of coal by straight lines of face has been the means of raising over 3,000,000 tons of coal during the past 10 years from two seams of coal, situate at 320 and 500 yards below the surface (now raising about 2,400 tons per day), with only one fatal accident at the coal face.

15618. (*Chairman.*) I understand you are a member of the Institution of Civil Engineers, a Fellow of the Geological Society, and you have practised as a mining engineer for about 30 years?—Yes.

15619. You are Chairman of Messrs. Pope & Pearson's Altofts Collieries, near Normanton, which raise about 630,000 tons of coal per annum?—Yes.

15620. One of the reasons why you wish to give evidence before the Commission is that you would like to go into detail with regard to the causes of the Altofts explosion?—Yes.

15621. You have your plans and sections exhibited here. Perhaps you will kindly give the Commission the result of your experience?—This is a colliery which is situate in Yorkshire, in which, on the 2nd October, 1886, an explosion took place in the Silkstone seam, which lies at a depth of 420 yards below the surface. The seam lies level. It is about 3 ft. 6 in. thick, and it had been working for 23 years without an accident.

15622. That is to say, without an explosion?—Yes, without a serious explosion. On this particular day nine men went down the pit to straighten this road which you will see marked "West Chain Road" on the cartoon (*pointing*). This was a main chain road bringing the coal from this north-west district along this main haulage road to the pit bottom, which is there (*indicating*). For some time before this accident we had been troubled, owing to the crookedness of the road, by the chain dragging against the side, and on this particular day the men went down to blow off about 4 ft. 6 in. from the side of this crooked roadway. The longitudinal section shows the position of three shots which were fired. No. 1, No. 2 and No. 3 shots (*indicating on the longitudinal section*).

15623. Where were they fired?—At the side of this main haulage road.

15624. But were they fired near the floor, or near the roof?—The first and second shots were fired, judging by certain indications, about 2 ft. from the floor; and they were fired at one time. We found that that was so in this way. I was leading an exploring party, and when we got to Roper's Drift I discovered the two men whose position is shown on that drawing, and marked 8 and 9; afterwards we went along the chain road and found these other men—in the position that is shown there (*indicating* 10, 11, 12, 13, 14, 15, 16 *on drawing*). I thought it would be a very good thing to have them sketched in position before anything was removed. That was done, and that showed us afterwards that No. 1 and No. 2 shots were fired at one time, and that No. 3 shot was fired a little time afterwards, because these men are close to the refuge place, opposite the first shot, whilst they were hiding from No. 3 shot. *That* man with his tools was in the refuge place, and these other men were shielding themselves behind those tubs. That is very important, because it tends to show that a commotion took place in the air, which raised a cloud of dust, so that when No. 3 shot was fired I can imagine that the atmosphere was just in right condition for an explosion.

15625. That short was fired very shortly after the other?—It was supposed to have been fired shortly after the other. No. 1 and No. 2 shots were fired first, because the men were at that time shielding themselves behind the tubs; but afterwards, when they came to fire No. 3 shot, they were in this refuge place, immediately opposite where they fired Nos. 1 and 2 shots.

15626. But would it not be a very curious thing that they should have fired No. 3 shot when there were clouds of dust still in the air from No. 2 shot?—We did not know the danger of coal dust in those days.

* See Plates XII. and XIII.

Digitized by Google

Mr. W. E. Garforth.

20 Mar. 1907

15627. You do not think it would have struck them that there was anything wrong about that?—No. You will notice this road is dotted on the plan in order to show that it was a full tub road. In those days the tubs were not kept as tight as they are now and the dust got through the jointings of the boards. There is a tub there, and then at 12 or 14 yards' distance another tub; so that if the distance between the tubs was rather greater than that, by reason of putting them on carelessly, the chain dragged along the bottom and ground up more dust, so that anyone passing along the pit would say "*That* is your full road and *that* your empty road," and the men cleaning up became accustomed to dust being always in the air.

15628. So that you think that even if there were immense clouds of dust raised by those first two shots, it would not occur to the men that there was any danger in firing the third shot—in those days?—No. Then the explosion originated from this No. 3 shot. We found those men with all their hair singed off (*pointing*). *This* man had his hair on because he was shielding himself in a refuge place. Two other men were blown down a road *here* some 40 or 50 yards.

15629. Absolutely blown along by the force?—Yes: after the men had filled the stone or dirt they went down Roper's Drift with a view of stowing it, and we found their bodies *here* (*indicating* 8 *and* 9 *on drawing*).

15630. So that they must have been at work some 40 or 50 yards at least away from the place at which you found them?—Yes.

15631. They must have been blown all that distance?—Yes, before the men went in the manager visited the place, and found they had put in a stone stopping, which was also blown away.

15632. (*Mr. Ratcliffe Ellis.*) Where is that shown?—That is not shown on this section, but it is shown on the other plan. These numbers 11, 13, 14, 10, 12, 15 and 16 correspond with those you see on the plan, and Nos. 8 and 9 is where the men were found down Roper's Drift (*pointing out on another drawing*).

15633. Where was the stopping?—It was *there*, shown by the two lines between the west chain road and main return.

15634. Then the stopping was blown down and the men were blown past the stopping?—Yes. Then the position of No. 3 shot is shown in that drawing (*pointing to longitudinal section*), because the question has often been asked, "Was not the roof above the No. 3 shot in a very broken condition?" As a matter of fact it was in very good condition, because this drawing was taken from measurements, and you will notice that no dust could lodge immediately above where the shot was fired; it was a smooth roof, but, no doubt, the dust was resting on those bars and timbers, and the packing at the side. This longitudinal section is produced to give you an idea of the destruction that was caused by the explosive blast. "Roper's Drift" on the cartoon corresponds with Roper's Drift which is marked on the section (*indicating*). There is not very much damage done here, because the roof was very good and there was very little timber. Where the timbers and bars were placed, the explosive blast displaced them, which, of course, allowed the debris to fall. At No. 10 haulage road (*indicating on drawing*), the red patch represents a fall, and in other places wherever you see a red patch that is placed to show a fall of roof. Along this chain road and this coal face we had not a single fall—I mean to say, £10 would have paid for all the damage that was caused in the main returns and the coal faces. Wherever a fall was found it was on a road where coal dust was. *This* portion was a very bad piece of road: the debris resting on the timbers before the explosion was displaced and the roof fell. This point (*indicating*) is just at the fringe of the shaft pillar. When this pit was sunk in 1863 they had not the knowledge they have now as to the size of pillar which should be left for a seam 420 yards deep. It was left too small, and great expense was incurred afterwards in having to make good the creep; at one time it was thought the pit would be lost. I mention that point particularly with regard to the question of dustless zones. Where I should recommend dustless zones would be where the tubs accumulate at the bottom of the shaft and at the main junctions in-bye end (*indicating on drawing*). The bumping together of the tubs creates dust. If you had a dustless zone near the fringe of the shaft pillar there would be a constant state of crush and a very great difficulty in maintaining it. At the end of this fall the tubs were all broken to pieces (*pointing to drawing*). We found one set of wheels with no body, sometimes a chain underneath the tubs, with the chain lying on the bottom of the floor and the tub on the top of it, showing that all this road had been affected.

15635. (*Chairman.*) Then the explosion gained in force, I suppose?—The explosion gained in force until it got to the junction of the West chain and No. 1 haulage roads (*indicating*). Along that road we had about 45,000 cubic feet of air per minute passing. When it got to this point it would meet with another supply of about 50,000 cubic feet of air. This was the No. 1 chain road which brought the largest quantity of coal from that long face which you see marked "December 2nd" running up to "December 1st." Then the violence on this No. 1 road (*indicating*) was very great. Two boys were found there with their backs and legs broken. There was a very big fall shown *there*, and other falls. The explosive blast, which did such destruction, gradually died away near the end of the haulage road, and when we got to the face and a certain distance up the road leading to the coal face, no damage was perceived; the coal faces were just as if the men had left them a week before, and everything was in the same condition. It was the same in all these stone-dust roads. What I mean is that as the coal face advances, to get the necessary height for the tubs and for the horses to pass we take out 4 ft. of stone, so that any little pieces of coal which have not been picked up in the process of working are completely smothered with stone. The explosive blast passed along *here*, and the moment it came to the stone-dust road it seemed to die away. The area of this goaf is about 800 acres (*pointing*), and becomes so consolidated that driving through it costs as much as driving through the solid coal. There was not any gas there, especially as we ventilate these roads, which are shown in green. The question was raised whether it was possible that the gas from a little seam of coal which varied from about 5 ft. to 14 or 15 ft. below the main seam had, by means of fissures, allowed gas to come up to this point (*indicating*). Some of the relatives of the men who were killed raised that point, and to satisfy them I ordered a pit to be sunk to this little seam of coal, but could not find any gas, and it was admitted that no gas could come from that source.

15636. Then when did you last see gas in the mine at all?—We never see gas except near the coal face.

15637. You do not see it at all except there?—No; and with the exception of this shaft pillar which is a very small area, it is about 900 yards from where the shot was fired to the coal face, and 1,700 or 1,800 yards before we get to the coal face again in the other direction. A point mentioned by Mr. Galloway was that near the stables there was a wet road down the east side dip. We found no damage on this road where it was wet. The engine-house pillar, which is at the intersection of No. 1 and west chain road, is a very thick stone wall, which would no doubt check the explosive blast as it came along. But as a matter of fact wherever the road was damp no damage was done. The explosive blast travelled on roads where coal dust was known to lie, and great violence was found; or where you notice the falls marked in white, the explosive blast caused a fire shown on plan, which we had great difficulty in putting out; it passed along the stable wet road, and no damage was done; it passed along the main chain road, and then, as I said before, died away on the stone roads.

15638. When you speak of a wet road do you mean wet everywhere—roof and sides, or only the floor?—It was only wet by bringing water to the stables, and being on an incline, water which percolated from the troughs would find its way for a certain distance down this road. It was simply a damp road; the water would not stand in pools.

15639. It was not watered at all?—It was never watered intentionally.

15640. It was simply wet by the water which happened to come from the spillings from buckets, and from other sources?—Yes; it was not watered intentionally, because we did not know the effect of coal dust then.

15641. So that the roof or sides were not watered at all, but only the floor?—Yes.

15642. Still, that was sufficient to stop the explosion?—That was sufficient—that and the wall.

15643. You do not know how much the wall may have helped to stop the explosion?—No.

15644. So that you cannot say for certain what would be the effect of watering this floor and having dry roof and sides, because the explosion was partly stopped by the

Digitized by Google

wall ?—Yes, but still I think we should give credit for the watering having had that effect, because it has done so elsewhere. With regard to the men, I should like to say: It is now 20 years since this explosion took place; I gave evidence in 1891 before the Coal Dust Commission, and since then another 15 years have elapsed, during which time I have had many opportunities of thinking about the matter and discussing it with other people, and the men have had the same opportunity. I put the question to them only last week: "Have you thought or seen or heard of anything which would cause you to alter your opinion that it was coal dust which was the cause?" I found that the men hold the same opinion that I do, that the explosion was caused by coal dust—that third shot being fired in the dusty atmosphere.

15645. You say this road was more or less wet, not because it was intentionally watered, but because it was accidentally watered. Did you notice whether there was a great deal of coal dust on the timbers ?—No.

15646. You did not notice any large amount of coal dust ?—No, not there at all.

15647. I was trying to find out the exact condition of this road which you called "wet." It was damp, if not wet, in places; there were just little pools of water on the floor ?—Yes, very little water.

15648. But you did not notice whether there was a great deal of coal dust hanging on to the timbers ?—No. I do not think there would be very much, because there was not the same amount of coal traffic on this road as on the other main roads.

15649. Of course you might have roads which were very wet on the floor, and there might be so much coal dust above that the explosion would still go through, that is to say that the explosion might be simply carried by the coal dust that was knocked down from the timbers by the explosion ?—Well, I take it that is what one wants to inquire into and obtain information about by experiments—what is the smallest quantity of dust which will carry on an explosion. Along *this* west chain road (*pointing on plan*) and the same on *that* No. 1 chain road, it was just like soot in a smoky chimney; you could scrape it off, and whenever a fall took place it formed a white patch as compared with the black sooty places.

15650. So that that long haulage road was naturally drier and dustier than the road which was more or less watered ?—Yes, every place was dry except *this* stable road; we used to find stalactites along this east side road; and then with the water dropping on the floor it was damp, and I used to say, "I wish all the place was like this." Of course, we only dealt with the dust as a matter of convenience, and not with regard to the question of danger.

15651. (*Sir Lindsay Wood.*) What are those pink roads which are marked on that drawing (*indicating*) ?—They are returns. There is something rather peculiar to be noticed near Roper's Drift. When this explosive blast took place, the main chain road was not as large a road as the return, and the explosive blast might have come down Roper's Drift, and found the readiest way to the upcast pit; but instead of that, we found no damage whatever in this return haulage road; the blast followed the trail of coal-dust for more than a mile in-bye.

15652. What was the description of explosive that was used ?—Ordinary gunpowder. The men found it easier to blow down 4 ft. rather than 3 ft., and got into the way of putting in a big charge, perhaps 2 lbs. This was a very badly planted shot. I have tried to show it here (*pointing to drawing*). There was a very small quantity of dirt found down afterwards and the stemming was blown, we imagine, and therefore the flame would come out perhaps *this* height from the floor, and in *that* direction as we could see from the remaining portion of the hole.

15652A. (*Mr. Ratcliffe Ellis.*) Those roads which go to the face from this haulage road marked pink (there are two pink roads) were roads from the face to the haulage road; I mean the roads which are shown up at the top ?—Yes.

15653. The blast went the whole length of that haulage road ?—Yes.

15654. Did it go up these roads at all ? (*Indicating*)—We could not find any trace. We were guided in our opinion as to where it had gone by the destruction. But when it got near the end of No. 1 road, after leaving *that* fall, we walked along the road and made the remark scores of times, "Why, not a sovereign's worth of damage has been done on the roads leading to the coal face or the nearest point to where gas would naturally be found."

15655. Those roads leading up to the face would not be dusty ?—No, because they were smothered with the stone dust, and there was so much less traffic on them. This main road supplied this district.

15656. So that, so far as you can see, the destruction followed the dust ?—Yes, and when the dust ceased the destruction ceased.

15657. (*Dr. Haldane.*) Do you mind showing me where the wall of the engine-house was exactly ?—You see we have a little part here (*pointing*); then the wall comes on *here*.

15658. But *this* is a main intake road. I do not see how it was obstructed by the wall of the engine-house. The explosion came down *here*; what was to prevent it from going along *here* ?—We had a wall *here* (*indicating*). It was outside the engine-house really, but it went along, and then it came to a very narrow place, just a doorway, where we got through. Here we discovered a boy, or, rather I found his trunk and part of an arm at one time, and then about a week or ten days afterwards we found the other part of his body when we were led by the smell. That boy was literally blown to pieces.

15659. (*Chairman.*) Then the explosion did go with great force past this wall apparently through the door ?—Yes, with tremendous force.

15660. And it immediately, or very soon, got stopped when it got into the wet road ?—Yes. Probably the door would be 3 ft. wide and 5 ft. high, and there was a corresponding door so that we could get through from the chain road into the stable road.

15661. Then you say that this watering of the floor only was sufficient to stop a very strong explosion indeed ?—It was.

15662. Because the explosion was very strong after it had passed the wall, I understand ?—Yes.

15663. (*Dr. Haldane.*) That was a regulated door, I suppose; it was not closed ?—No, it was always open, simply to get from one side to the other.

15664. (*Sir Lindsay Wood.*) You mean free of access, but not kept open ?—No—free of access.

15665. I think you said that it was always kept open.—Well, I do not think we noticed that; it would probably be off its hinges at that time, as some repairs were being done near the engine house.

15666. (*Dr. Haldane.*) Where was the air coming through that intake ?—*This* is the downcast pit, and *this* is the upcast pit (*pointing*).

15667. And *this* is an overcast ?—This is an overcast, or rather, two overcasts; they were made of stone and they were blown up. We always had to be very particular not to move anything, because this part of the shaft was always ready to get on creep, and everything was done to make it as strong as possible in order to make up for the loss of the pillar of coal.

15668. The explosion could have come round *this way* (*pointing*) ?—It did; there was a lamp-cabin near the downcast, and the lamp-man and his son were saved; in fact, I got his boy out; and the lamp-man said that as soon as he saw this light coming—the atmosphere was lighted—he said to the boy, "Lie down," and the boy lay down, and he said the flame came into the cabin, ran round the place, went out again, and scarcely burnt them at all. Another man who had not taken the precaution of lying down sustained burns which were so severe that he died about 10 days afterwards.

15669. (*Mr. Ratcliffe Ellis.*) Was there dust in the cabin ?—Yes, there was dust all over the shaft bottom and roadways near. The surface screens were near the pit top and the dust went down. Since we commenced to collect the dust in boxes placed in the shaft, we know from the quantity of dust collected from a certain area, and by taking the area of the shaft, there must have been dust everywhere, and there still is, though we adopt many precautions now which we neglected formerly.

15670. (*Chairman.*) How do you collect the dust now ? Do you collect it dry ?—Yes, but we do not collect it as Mr. Fowler collects it. The precautions we take now as compared with what we did in 1886, are these: Permitted explosives instead of gunpowder. When a shot has to be fired on a main haulage road, watering the floor, sweeping the sides, roof and bars within a radius of 20 yards on each side of the shot as per General Rule 12, (Clause (*h*), subsection 1, and Explosives in Coal Mines Order, 1896 (now the Consolidated Order of December, 1906).

Digitized by Google

Mr. W. E. Garforth.

20 Mar. 1907

15671. You say watering the floor—not the roof and sides first ?—We dare not water the roof and sides.

15672. Even for shot firing ?—No. I should like to show you the photographs which I have here by which I can show how watering affects the roof and sides.

15673. You consider that Rule 12 is sufficiently complied with if you water the floor and not the roof and sides ?—Yes. I brought this sample of stone (*produced*), as I thought you would like to see the nature of the stone ; *that* is from the Diamond Seam, and *this* from the Silkstone Seam. *That* stone exists for about 12 ft. above the Silkstone Seam, and the other about 10 yards above the Diamond Seam. This photograph, which was taken down in the pit, by the help of a number of incandescent electric lights, shows how the roof is affected by watering ; it brings it down as you see it is in that photograph (*exhibiting photographs*).* If you put those pieces of stone in this tray you will see in about half-an-hour's time how the shale falls into small pieces. (*The witness placed the samples of stone referred to in a tray and poured water on them.*)†

15674. Will you continue to explain what extra precautions you take for safety with regard to the dust ?—No two shots are fired in close proximity unless a certain amount of time elapses and a second examination is made. (See Explosives Order, 1906, Section 2, Sub-section (*h*). Then with regard to the tubs, which were formerly not very well put together and which allowed the dust to come through, we now have iron bottoms and they are tongued and grooved.

15675. That is to say, wooden tubs with iron bottoms to them ?—Yes, and in the lower seam we are gradually replacing some of the wooden tubs by iron tubs, although that system cannot be carried out at all collieries.

15676. Why should it not be carried out ?—In the steep mines, for instance, you may have runaway tubs in the brow.

15677. Through the tubs being too heavy, you mean ?—They get so damaged that the cost is very great. We have in this pit inclines of 1 in 7, but that is not like the mine which I am connected with in Lancashire where the inclines are 1 in 3, and occasionally a greater incline even than that. Then the next point with regard to coal dust is long rails instead of short ones in the main haulage roads. If the 4 ft. or 6 ft. rails are not properly laid they cause a little bump as the tubs are going along the road.

15678. That throws up the dust ?—That throws up the dust. Now we have 12 ft. rails. Then : Rope haulage with tubs lashed instead of chain haulage dragging on the top of the tubs grinding the coal to small if there is a block on the road. The next precaution we take is : Main roads kept as straight as possible to prevent the rope or chain haulage from knocking the coal off the tubs. Ground floor to the pit hill level near the shaft covered in to prevent as much dust as possible going down the shaft from the screens, that is to say, where the rail level is we have carried a screen up.

15679. (*Mr. Ratcliffe Ellis.*) That is on the surface ?—Yes—I have got to the surface now.

15680. (*Chairman.*) That is efficacious ; it would not be necessary in that case to prevent the screens being placed near the shaft ?—Well, this pit has been going for 55 years, and we could not move the screens.

15681. No, but do you suggest that the precautions you take are quite as efficacious as if you moved the screens some distance from the shaft, supposing you could do so ?—I think the combination of the two would be the best—not too far away to interfere with economical working.

15682. Then if you could put the screens a certain distance, say 60 yards away, you would do so notwithstanding that you had adopted other precautions as well ?—Yes. I should adopt the further precaution, because it is only thin sheet steel. Then : Straight faces, as compared with the crooked or step faces, which permit of a better circulation of the air. I thought I should like to bring that point before you afterwards ; it is quite a different matter to this, but still it has its influence. That is shown on another Plan.‡ In the Diamond and the Silkstone seams we worked 3,000,000 tons of coal and only had one fatal accident, and we attribute that in a very great measure to the straight line of cut, which leaves large blocks instead of broken strata. Instead of the coal coming away with a great number of jagged points now we get it more cubical.

15683. Have you much decreased the dust ?—Yes. We never thought much about it in connection with danger, but it is really one of the things that have been considered.

15684. As a means of decreasing the dust ?—Yes, we have less dust at our faces. Then the next point with regard to dust is ; Method of working coal face in straight lines : consequently haulage roads in the end gates not so heavily timbered, and consequently less bars for dust to settle on. With regard to the end gates which you see on the Plan, we have 29 gates of about 200 yards each, and there is not a scrap of timber in them, because the line of cut being straight produces a straight break in the roof, and the straight break in the roof makes the blocks from one break to another 5 ft. 6 in. ; consequently it settles down much quicker in these large blocks, and very little timbering is required in the gates.

15685. So that this is a means of avoiding not only explosions from coal dust by means of diminishing the dust, but also avoiding falls of roof and sides ?—Certainly ; If we watered these roofs I am sure we should have many more accidents from falls of roof and sides than from loss of life by explosions. We have only lost 22 lives in 53 years by one explosion.

15686. You can water the floor ?—Yes, but we do not go above the floor : we are always very careful not to let the water spray on the sides : we keep it on the floor.

15687. Then the floor can be as wet as you please without doing any harm, can it ?—Well, we never carry it on to that extent.

15688. But still you make it sufficiently wet to lay the dust ?—Yes : those are the precautions we have taken since the explosion, and it is now 20 years since that accident took place.

15689. Then in point of fact since you have adopted this process you have had very little timbering ?—Yes, in the gates ; but then the cross gates require a little more, because you get the cleatage lines in the strata at an angle.

15690. Is your system being adopted in other places where it is possible ? Do you know at all what is going on in other collieries with regard to your system ?—Yes, there are many other collieries that I know about, but I should much prefer, if it is agreeable to you, to speak about the colliery which I have charge of.

15691. Have you, for instance, at any conference of mine-owners, or mining engineers, or anything of that sort, discussed this method ?—That has been brought before the Institution of Mining Engineers, and a Paper written on the subject to point out this straight line of cut.

15692. Is the straight line of cut now being generally adopted ?—It is in those collieries where they have machines. It is only by machine work that you can do it : for instance, you see there is shown there (*pointing to drawing*) the old system of working. On *that* Plan§ you see the irregular face just below the words "solid coal" : that is compared with those straight lines (*pointing*). *These* are the different breaks which we can trace right away through the waste, through the gateways, and through the other waste, and the straight lines correspond.

15693. Then in your opinion it is better to use the coal-cutting machinery ?—Yes, in those mines where it can be worked. I have some short notes showing the places where dust is made and collects. These places may be sub-divided under three heads, namely, coal dust which is easily visible or in large quantity; coal dust in small quantity, but noticeable on inspection ; and coal dust only to be noticed by careful inspection. I have a list here of 20 or 30 different causes of coal dust, which I can place before you if you wish.

15694. When you say "causes" do you mean, for instance, dust being shaken from tubs, and that sort of thing ?—Yes. To begin at the face. When the coal-cutting machine is allowed by careless working to cut into the coal instead of in the dirt, a large quantity of dust is made. You can quite understand that a disc machine revolving and cutting in coal sends the dust in all directions : the proper thing is to cut in the dirt, and then that same dust goes to dilute the coal dust ; so that in one case it is an advantage, and in the other a disadvantage.

* See Plate XIV.

† The samples of stone became disintegrated very quickly and fell into small within the time mentioned by the witness. (S.W.H.)

‡ See Plate XV.

§ See Plates XVI. and XVII.

Digitized by Google

Photographs showing the effect of watering the roadways in the Diamond Seam, 1,500 feet below the surface, at Messrs. Pope & Pearson's Collieries, Altofts.

(Handed in by Mr. W. E. Garforth.)

1.

Height of roadway 5 ft. 4 ins., width 7 ft. 0 ins. No repairs done for over three years.

1a.

After watering the Roadway two yards on each side, the wooden stretcher or bar and several tubs of dirt fell within half an hour.

2.

Height of roadway 8 ft. 0 ins., width 7 ft. 0 ins. Five stretchers set in eight yards; no repairs done for over three years.

2a.

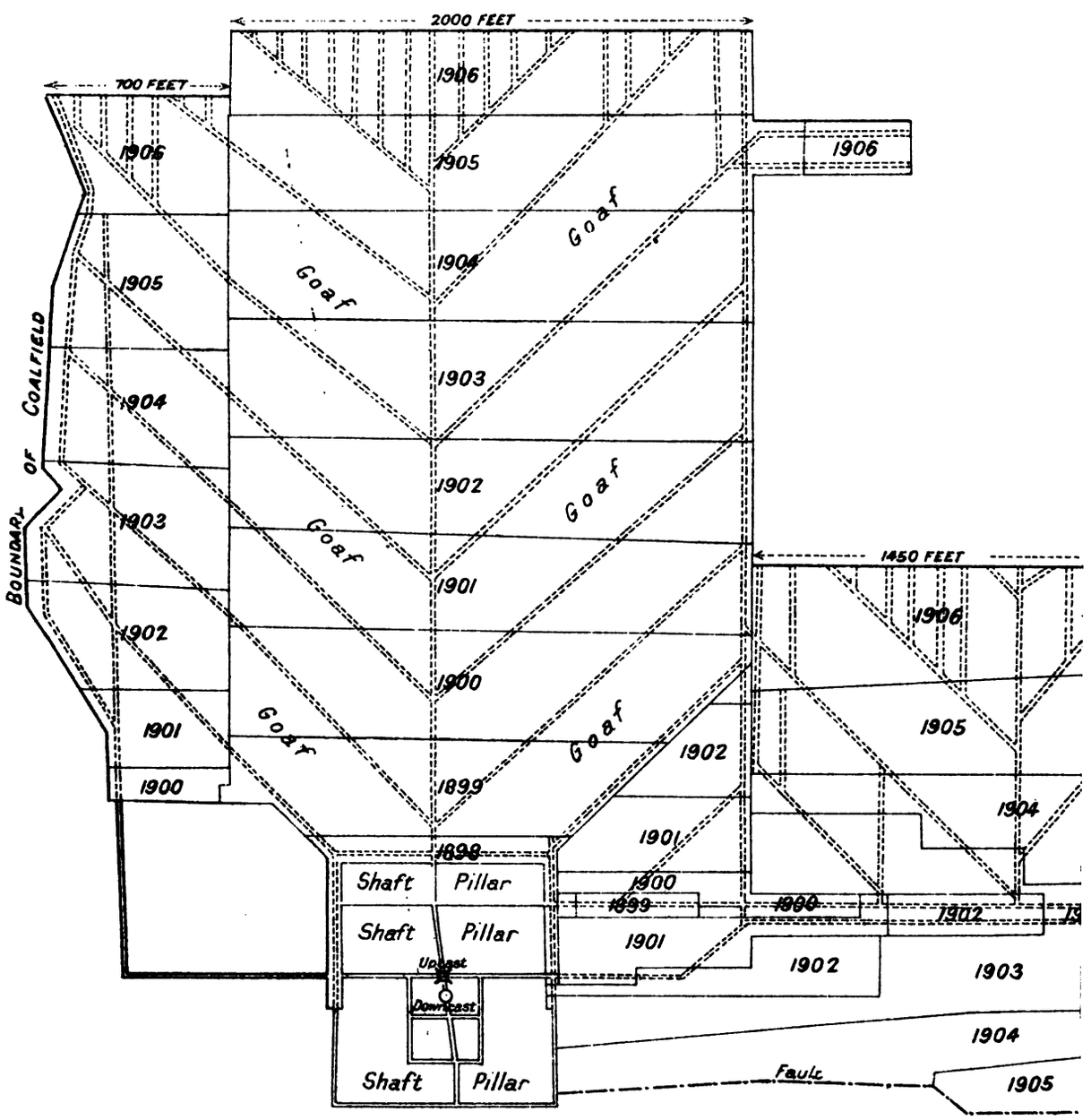
After watering the sides and roof, four wooden stretchers fell in eighty minutes, which caused a large quantity of dirt to fall, and produced weighting of the roof.

Digitized by Google

Digitized by Google

Plan of Workings in the Diamond Seam, 3'-3" thick 500

at Pope and Pearson's Collieries, Altofts.



SCALE 660 FEET TO ONE INCH.

601. 6. 07

Weller & Graham, Ltd · Litho, London.

601. 6. 07

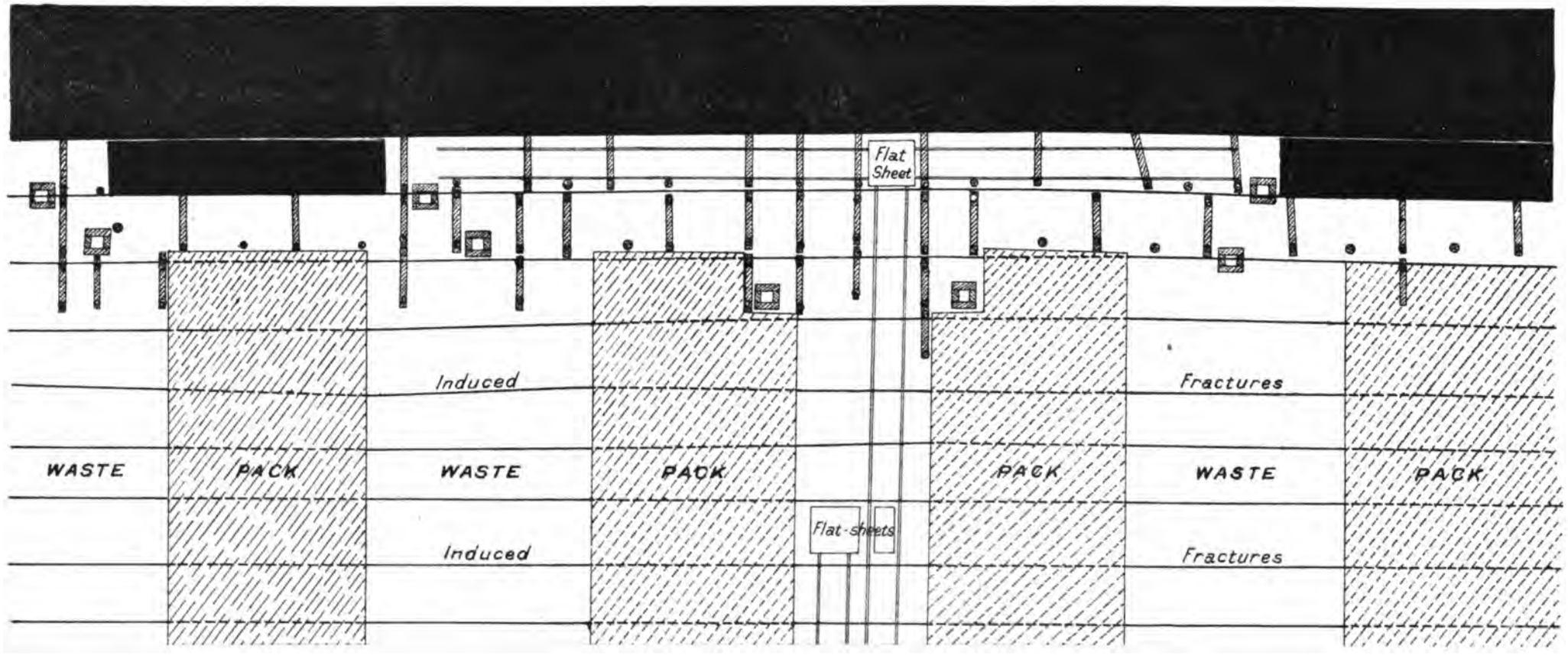
Weller & Gra

Digitized by Google

Digitized by Google

STRAIGHT HOLEING AND STRAIGHT TIMBERING WITH REGULAR INDUCED FRACTURES,

AT POPE AND PEARSON'S COLLIERIES. ALTOFTS.



XXII.

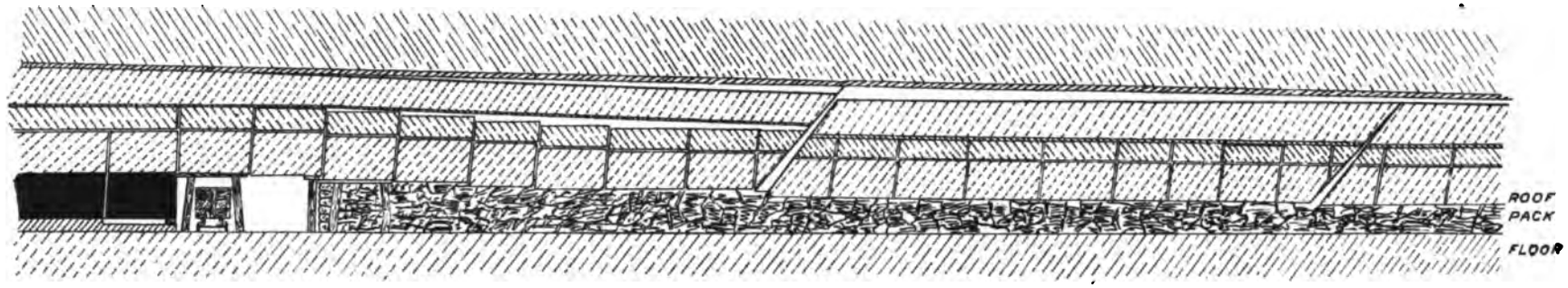
Digitized by Google

801. 6.07

Weller & Graham, Ltd · Litho, London.

Digitized by Google

Longitudinal section of Coal face regular line of Breaks, and Pack at Pope and Pearson's Collieries, Altofts.



SCALE 12 FEET TO ONE INCH.

Irregular line of Break resulting from Hand-Holeing.

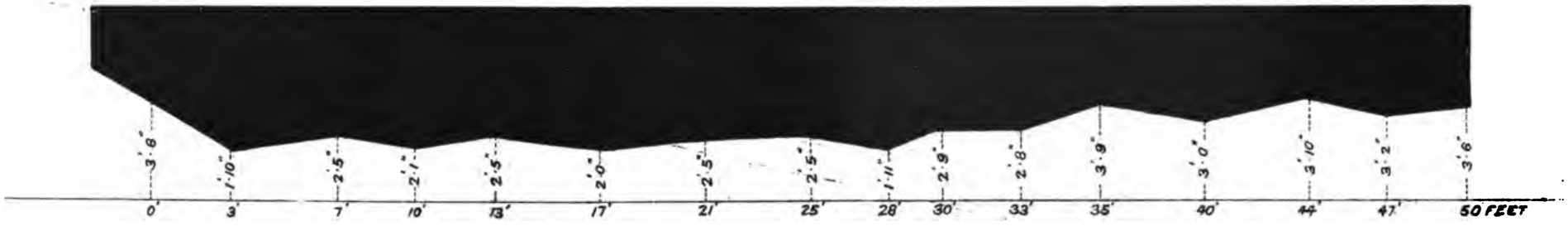


Plate XVII.

Digitized by Google

801. 6.07

Weller & Graham, Ltd · Litho, London.

Digitized by Google

15695. Therefore, you must be very careful how you use these machines?—Yes. We have a means of checking it, because as we go along the face after the men have finished with the machine, if there happens to be a heap of dirt there we know they have been cutting in the dirt, and if, instead, there is much coal dust, we know they have been cutting in the coal, or a mixture of the two we know how the cutting has been done. Then the next source of dust is from filling the tub, in which operation dust and small coal is formed. Then on the main haulage roads: dust is shaken off the tubs by running into one another at the end of the haulage rope; dust falls through leaky tubs on the main rope road; collisions or run-aways on a haulage road; or by upsetting the tubs. All produce a quantity of dust. Then in the main junctions and in the standage at the pit bottom, dust is formed by the tubs bumping into one another. Where the haulage is main and tail rope running 8 to 10 miles an hour against the air current, considerable quantities of dust are blown from the tops of the tubs.

Dust is blown out of the tubs when being wound up the pit at a high velocity against the ventilating current.

Surface dust is brought down the pit from the screens in large quantities when the wind is in certain directions.

Dust is formed when the sprags are removed from under the coal and it is allowed to fall.

When explosives are used for getting down the coal, dust is formed in drilling shot holes and by the explosion.

Coal cutting with the pick and splitting it up for filling into the tubs.

The small coal which is jolted off the tubs is ground up into dust by men and horses travelling. This does not apply when separate travelling roads exist.

If the system of haulage is endless chain, quantities of dust are made if the tubs are stopped by any cause and the chain drags over the top of the coal.

Small coal that falls off the tubs when they are taken from the coal face to the pass-bye is afterwards crushed into dust by being trodden on.

Each time the horse starts a journey of tubs, dust is shaken from them.

When the system of haulage is endless rope over the tubs and the roads are not perfectly straight, the rope moving sideways on the tubs produces dust.

However slowly the tubs are drawn towards the shaft some dust is blown out of them by the ingoing air.

Generally, wherever a tub loaded with coal is jolted, dust is shaken from the tub, either off the tub or through the bottom.

The weight of the superincumbent strata on the shaft pillar and main road pillars (if any) crushes the pillars, and is constantly forming small quantities of dust.

I do not think I have any further statement to make, but I shall be very glad to answer any questions. I do not know whether you would care to take my opinion with regard to experiments which I think ought to be conducted.

15696-7. A Committee has been formed, as you are, I think, aware, to consider that matter; but would you like to mention to the Commission now your views on the subject?—My suggested list of experiments on coal dust is:—(1) To prove that coal dust without the presence of firedamp is explosive.

(2) Having proved No. 1, to find what is the smallest proportion of dust in air which is explosive and what proportion is most explosive. Under this head dust from various districts and collieries should be tried to ascertain whether the dust from certain seams is more explosive than from others.

(3) Having obtained repeatedly explosions such as described in No. 2, to prove whether an admixture of dirt, dust and coal dust can be obtained to produce a similar explosion. To continue these experiments until the percentage of dirt dust over coal dust is such that no explosion results.

(4) Having got an initial explosion to prove what length of gallery is required to make the explosive blast equal in violence and velocity to the explosive blast which caused the destruction which explorers have noticed during recovery of a mine.

(5) Having produced No. 4 with an excessive quantity of dust on the bars, sides and floor, to try the smallest proportion of dust which will carry forward an explosive blast.

(6) To repeat No. 5, but at an interval of time when it is supposed a small quantity of coal dust will be in suspension. To see if a second shot fired would cause an explosion where No. 2 experiment failed to do.

(7) Having obtained an explosion by means of any of the foregoing, then to have the gallery so covered with dust that the flame is fed by an excessive quantity of coal dust and an excessive quantity of fresh air with a view of proving what is the greatest destructive force which can be got in the shortest length of gallery. (*a*) To get the conditions suitable for producing these explosions so measured or defined that experiments may be made five successive times with the same result. (*b*) To ascertain the velocity of the explosive blasts. (*c*) If possible to photograph the explosive blasts. It is desirable that artificial gas in every form should be kept from the gallery, although many interesting experiments might be carried on by igniting the gas by certain of the foregoing explosions, thereby increasing the violence of the explosions by the presence of small quantities of gas. (*d*) To obtain photographs of the dust floating in the atmosphere of the gallery by means of electric light similar to a beam of sunlight.

(8) Having got by the preceding experiments an explosion of great destructive force, to have an additional tube attached to see what further length of watered roadways is required to extinguish the flame or reduce it to inertness, and to ascertain by tests what the temperature of the blast is after passing the wet zone.

(9) Having tried the water zone in a tube arranged like a dry and dusty mine, say by means of exhaust or high-pressure steam, and thereby obtained an atmosphere of 75 to 80 deg., equal to the temperature of a mine 500 to 600 yards deep, to see what length of a dustless zone is required to reduce such force to inertness and to ascertain the temperature of the blast after passing the dustless zone.

(10) Having carried out 7 and 8 to prove what length of roadway will form a similar safety zone to that found in tests 7 and 8, when the coal dust is mixed with a certain proportion of stone dust as ascertained by experiment No. 3.

(11) To find whether pure dirt dust, got from a road that has just been ripped, will reduce the flame and with a less length of safety zone.

(12) To cover the safety zone with a certain proportion of salt or certain other chemical substances which may be suggested to render the dust non-explosive or reduce the temperature of the blast, &c.

(13) On the principle that the flame may keep near the roof to test whether a chemical substance should be distributed on the bars. &c.

15698. Naturally you will put all those considerations before the Committee?—Yes.

15699. (*Mr. Cunynghame.*) I do not know that I have much to ask you on the coal dust question; we have heard your views, and we have had a great deal of information on the subject before. I should like to ask you something about safety lamps. I think you have made a good many experiments with safety lamps, and you are rather an expert on that subject?—I had a good deal to do with lamps 20 years ago.

15700. It occurs to me, looking at the safety lamp as at present used, that it is a very imperfect instrument. Would you agree that it gives at the beginning of the day only a light of about a candle power, and that towards the end of the day the light it gives diminishes often to two-thirds of a candle power; is that about right?—We used to say that assuming a candle burning 120 grains sperm per hour had a light equal to 100, then a safety lamp was equal to from about 64 to 70.

15701. Towards the end of the day, or was that even at the beginning of the day?—I think that is about the average—64 to 70.

15702. Not only that, but it has a further defect in that it casts a cone of darkness upwards and a cone of darkness downwards?—Yes.

15703. So that that again will perhaps reduce its efficiency by a further percentage?—Yes.

15704. Then it seems to me to have a second defect; if turned at a very small angle it goes out?—Yes, that is the case with the Muesler chimney.

15705. And with most safety lamps now?—Yes. It was proved in the experiments which we conducted about 1883 that we must have a lamp to resist about 42 ft.

Digitized by Google

Mr. W. E. Garforth.

20 Mar. 1907

velocity per second to deal with those large volumes of air that you get in the main returns; and therefore the lamps without the Muesler chimney would not stand that velocity.

15706. You mean they would explode?—Yes. You can get such a velocity passing the top of the Muesler chimney that the explosive current will actually draw, on the principle of the injector, a flame from the wick to the top of the chimney, when the Muesler lamp has simply a gauze between the gas and the flame, like an ordinary Davy lamp.

15707. A few of the older patterns of those lamps will bear to be held horizontally for a second or two?—Yes.

15708. But only a few of them?—Yes.

15709. The most modern types and the safest types go out immediately they are inclined at an angle of about 30 deg., I believe?—They do.

15710. That consequently causes a necessity for a considerable amount of lamp re-lighting below the surface?—Yes.

15711. Can you give us any idea—I am not asking necessarily with regard to your own colliery—of the percentage of lamps which are re-lit?—Yes, I can give you the figures daily. I mean to say in our case nearly every man is supplied with two lamps.*

15712. I think these general impressions will be quite sufficient, because they can be corrected. Do you mean that each man carries down two lamps?—Yes, each man connected with coal-face work.

15713. That is, that you have an extra lamp for every single man?—Yes, at the face.

15714. So that you do not re-light them at all below; you send them down re-lit?—Yes; because we look upon the safety of the pit like the strength of a chain, that it is only equal to the most careless man or the most unsafe appliance, and I do not think they have these appliances for re-lighting sufficiently perfect at the present time; we look upon them with suspicion.

15715. (*Mr. Ratcliffe Ellis.*) But although you supply two lamps to each man, does one always go out?—Sometimes one man brings two back alight; I have often seen a man come back to the surface with two lamps lit, and have said to him, "Why did you not put those out?" He has been working with them all day.

15716. (*Mr. Cunynghame.*) The fact that you find it necessary to send two lamps down is an argument showing that a large number require to be re-lit. Would it surprise you to learn that in one colliery where we asked the question we found as much as 30 per cent. of the lamps re-lit in the day? I am not blaming the men or the owners.—I daresay that might be so.

15717. I am coming to the question of electric lamps, and I wanted to lay some foundation for some questions about them. In the next place do you happen to have ever read a Report made in 1891 by Dr. Cort, about miners' nystagmus?—Yes.

15718. That is a very curious Report?—Yes.

15719. Do you remember that he points out that whereas out of 500 men who were working with safety lamps he found over 100 suffering from miners' nystagmus, and when he came to men who were working with naked torches in naked light mines only 3 men out of 500 were found to be suffering from nystagmus; from which he concludes that it is not the straining of the eyes upwards in any direction, but that it is simply the deficiency of light which is the chief cause of nystagmus. Can you give us any information on that point?—I cannot; I have not considered it sufficiently to give an opinion. There is this to be said, that when a man is working in a horizontal position, as when he is holeing the coal or dirt, I think that position is more liable to cause what you mention than standing during the operation of filling tubs.

15720. One would think so, but the extraordinary thing is that they examined 500 men who had been working with naked lights, and lying horizontally in exactly the same position as if they had had safety lamps, and only three of those men were found affected?—Yes.

15721. If those results are true I think you will find that is a matter which is very well worth looking into?—No doubt.

15722. Dr. Snell's opinion, I believe, is quite different from that. Unless there was some extraordinary error made by Dr. Cort—and one cannot suggest any reason why he should have favoured one lamp more than another—the result is a very curious one?—It is. Still, I think when you come to look at the construction of a safety lamp you must have safety first, and consider the question of the men's eyesight afterwards.

15723. Yes, we agree?—I thought many years ago that when you could not get both a safe light and resistance to velocity in one vessel you might do something by getting a second form of vessel, that is to say, take the ordinary Davy lamp with the gauze, put on that a chimney, then put on a tin shield; all these are really obstructions to prevent the explosive gas getting to the lamp. When it does get to the lamp, the internal explosion which takes place makes the lamp self-extinguishable. I took one of the most modern lamps and put it into different working places down the pit (I think I tested 31). I found that in not a single case would the modern lamp indicate the presence of gas, while the Davy lamp indicated it 20 times, because there was only just the gauze between the flame and the outside atmosphere. Then I brought out the little indiarubber bag, about the size of a pear, so that instead of taking a modern lamp and putting it into the atmosphere which you want it to test, you keep your lamp down in a safe atmosphere, take the bag, squeeze the contents out, then allow it to expand, which it does, and at the same time draws a sample of the atmosphere which you want to test. Squeeze the sample into a tube running alongside the pricker tube, which communicates with the flame; then if gas is present it shows the elongation of the flame in the ordinary way. That is simply done to get proper tests for the presence of gas, and to resist velocity; you cannot get both advantages in one lamp.

15724. Owing to the peculiarity of the lamp that goes out when inclined at a comparatively small angle, it becomes exceedingly difficult, does it not, to effectively use these lamps for the examination of roofs?—It does.

15725. You have a cone of rays thrown upwards, which to a large extent prevents you doing that?—Yes.

15726. Have you tried electric lamps?—Yes.

15727. If properly constructed they could be made to give a light of two or three candles, could they not—enough, if Dr. Cort is right, to put an end to miners' nystagmus, for one thing?—Yes.

15728. And to make it more convenient for work, as another thing?—Yes. You will presently have before you the man wearing the life-saving apparatus, and you will be able to see an electric light which he used, which lasts about 10 hours, and it is only of a small size. A great many men recognise what a large business could be done if they could get a good electric lamp with a battery; this apparatus which you will see presently is one of the best. There are a great number of ingenious men trying to get this improved lamp, because we all know that cracks in the roof and many things with regard to the coal face ought to be closely examined with a good light.

15729. In other words, if you could get a thoroughly effective electric lamp it would be the best lamp?—Yes, it goes without saying.

15730. But I will mention now its possible disadvantage; if the glass is broken it is liable to ignite gas, is it not?—Yes.

15731. It is not always that it does so, but it may do it sometimes. One can show that it will do so sometimes?—Yes, one can do it a few times.

15732. But if a pick struck an electric lamp what would be the odds that it would ignite a thoroughly ignitable atmosphere around it?—I believe it can be done as many as seven times out of 10.

15733. I suppose the glass could be so protected that there would not be much danger of the lamp being damaged by a blow any more than, for that matter, an ordinary safety lamp would be damaged by a blow?—That is so; and judging by the way in which the men have taken to or used safety lamps as compared with the old candles, I believe if we had a good electric lamp the men would be found in a very short time to be capable of taking care of it.

15734. Of course, if the men would use them carefully

* Mr. Garforth subsequently ascertained that at his Colliery there were 1980 lamps in use for 1222 men and boys employed underground, or an average of 1·6 for *all* employed—that is to say, *two* for all stallmen, machinemen, etc., and *one* for drivers and others on the roads.

Digitized by Google

they would be incomparably safer as far as the ignition of gas is concerned, because they cannot ignite gas unless broken, no matter what the amount of gas may be?—If we had a good electric lamp I feel sure the men would use it properly.

15735. I believe that one of the great complaints as to electric lamps hitherto has been as to the accumulator, that has been the great difficulty.—Yes.

15736. I suggest to you the question is whether the giving out of the accumulators is not really due to overcharging on the surface, so that the grid on which the paste is supported is really turned into a paste and the whole thing gives way. Have you had any experience of that?—I have not.

15737. So that if you could have a blow off indicator or some means of stopping the charging on the surface when the battery was really giving out, you would get a life of some three or four years out of your accumulator without any difficulty?—Yes.

15738. Then in that case the electric lamp would be quite an economy, as I think everybody is agreed—that is if you could get anything like that light.—Yes. Of course you must bear in mind that when a man goes into a place containing gas, his safety lamp is an indication, because of the elongation of the flame; but when he uses an electric lamp, it is entirely isolated from the surrounding atmosphere, and a man might be found suffocated and yet the lamp be burning brightly.

15739. You mean the safety lamp gives an indication of black damp?—Also of firedamp.

15740. I will take the case of firedamp. Have you ever tried an apparatus, invented, I think, by Lieving—a little thing which could be joined on to an electric safety lamp? It is a little electric wire itself screened by a Davy gauze, and then when you touch a button it goes to a faint red glow: but if there is a trace of gas there it immediately becomes bright?—Yes. There is a better way than that for a new electric lamp: that is, in addition to your little carbon filament, in its hermetically-sealed case, you carry a little wire of platinum between two globes, the space between being connected with the atmosphere. Then take the bag of firedamp and insert it on to the platinum wire, when, if there is 3 per cent., it glows from there to there; but if there is more than that it glows for a longer length and thus get an indication at once of the presence of firedamp; so that a man going into a working place will keep his electric lamp in a safe place, put up his collector, or bag, and bring the suspected atmosphere down to see the glowing of the wire. When you get an electric lamp with a small portable battery there are many things which may be done to help the miner.

15741. And there would be no objection on the ground of not being able to detect firedamp with it, because it would afford, if properly rigged up, the very means of doing it?—Yes.

15742. Yes, and in that way you could give the special lamps to the special men who were requiring them?—Yes.

15743-6. Leaving the ordinary lamps to be used for coal-getting by the men who did not want the special lamps?—Yes. Besides there is now better inspection.

15747. It is possible that by means of electric lamps nystagmus might be cured, if Dr. Cort is right?—Yes.

15748. So that we shall kill three or four birds, apparently, with one stone, if we get an electric lamp?—Yes.

15749. Therefore I understand your experience, which is a large one, is in favour of electric lighting, and you believe it to be possible?—Yes, I think so.

15750. I do not know whether your attention has been called to what the French have been doing with regard to electric lamps in mines?—I have not seen that.

15751. Over there the electric light company undertake for 2 francs 50 per month per light, to provide, maintain, keep in order, and charge the electric lamps in a mine. We have had a most elaborate calculation given to us of the expense, and it was shown that, capital and interest together, it did not exceed the price of oil?—Yes. We must go a step beyond that: we must not put our pits in charge of electricians who are making a profit out of it, but must consider the question of safety first and profit afterwards.

15752-5. I quite agree; but they send their own skilled electricians. The electricians do not go below at all, but they simply hand the lamp out on the surface and if it goes out they get no pay. They get 2 francs 50 per month for those that remain in.—They did the same kind of thing when the use of mineral oil came in instead of colza.

15756. I think you are an advocate for something being done in regard to the erection of a lamp-testing station and the proper testing of lamps?—Yes.

15757. (*Chairman.*) Is the eye disease which you have mentioned a serious disease?—We have heard a great deal about it lately. I understand it is serious.

15758. (*Sir Lindsay Wood.*) You say that your men take two lamps per man down the mine in going to work?—Yes.

15759. Is that done in any other colliery?—I think it is done in a good many. You see we were formerly troubled by men coming back without light, and men lost their labour in that way.

15760. I am not giving evidence, but I may say I never heard of such a case. I do not know of any colliery in which it is done?—I can give you the exact number of men we send down the pit and the lamps they take with them; it is registered every day.

15761. In collieries in Durham they are not allowed to take any lamp down except their own lamp?—Are you using the Muesler—because it makes all the difference? We never gave out two lamps with the old Clanny or the Davy, but it was only when the Muesler came in that we gave the stall men two lamps to prevent their coming back again. When a man gets two miles from the pit bottom it is a very serious thing for him to lose his labour by reason of having to come back.

15762. But in some cases we have men who are three miles away from the pit bottom and we have never allowed a man to have anything but his own lamp with him. Amongst 30 men I should think there are not more than four or five spare lamps taken down, and those lamps are all locked up in a cage in charge of the fireman, and no man can get a lamp out unless he goes to the fireman to get one. Those four or five lamps are always burning, and if a man puts his lamp out he goes to the fireman who is near to the face and gets a spare lamp; cases of a man getting a new lamp are reported to the manager of the colliery and the cause of the old one going out is inquired into?—In the old system of working with five or six men in a stall we used to let them have one extra lamp, and if that lamp was lost they would have still four or five lamps to work with.

15763. Do you say that in the old system of working every man would take two lamps with him?—Working with the Muesler every stallman takes two lamps with him.

15764. Of course it would be increasing the danger?—Yes, of course it would be, on the principle which you have mentioned.

15765. In the case of the Muesler lamps you do not think that is so?—I do think so.

15766. You think about 30 per cent. of the lamps that go out every day are relighted?—Yes. I should like to send up the exact figures in order to give a correct reply to that question, because we have the figures.

15767. You spoke about the high velocity of the intake current putting out the lamps?—That was not in the mine but in the experiments which we conducted at Aldwarke Main. We found when we got a velocity of 42 ft. per second there was a sufficient velocity passing along on the top of the tube to draw, on the principle of the injector, the flame up that chimney, when it would simply burn as a flame on the top nearly opposite the holes of the tin shield. Therefore there was simply a gauze between the gas and the flame like the old Davy; but at 20 ft. or 30 ft. per second nothing of that kind took place.

15768. What description of lamp was that?—That was the Muesler. It was the same with the Marsaut lamp; and on one occasion we got such an intense heat in the double gauze of the Marsaut lamp that we sent word to the maker. He said "I cannot understand how you could see whether the gauze was red hot or not, because there is a tin shield in front of it"; but further correspondence showed him that those two gauzes were glowing like a furnace and the reflection was shown on the rim on which the standards are formed.

15769. Do you know of any collieries using electric lamps?—Yes, there are several collieries in Lancashire using them and some in Yorkshire.

15770. There are some collieries in Durham using electric lamps, too, I think. The difficulty has been with the batteries?—Yes.

Digitized by Google

Mr. W. E. Garforth.

20 Mar. 1907

15771. But those are being very much improved of late?—Yes, very much improved.

15772. Now that almost every colliery has a supply of electricity they can charge those batteries very much more easily than they could do. Two years ago they required a special plant for charging them?—Yes. We have had several different things improved upon, such as men having stations to which they can go back in order to exchange lamps and re-charging.

15773. In the case of Altoft's colliery you have mentioned you say there is a straight coal face which you thought was the cause of a great many lives being saved from falls of stone?—Yes; we have only had one fatal accident for 3,000,000 tons of coal raised during the last 10 years.

15774. Are the breakages or cleavages in the stone almost always parallel?—Yes, quite parallel. That seam which is shown on the drawing behind you has been worked now for eight and a-half years, and during the whole of that time we have never had a fatal accident at the coal face. It is raising now about 1,200 to 1,300 tons per day.

15775. What was the proportion before you adopted this straight system?—It has never been worked on any system but straight lines.

15776. Is there any likelihood of the break slipping down close to the face where the men are?—No, we have never had any experience of that kind. It is in a large block, and the timbering is done as you see it shown on the drawing. The man does not fill in front of the coal; the machine cuts, and a complete fracture is produced owing to the depth of the holeing, which is sufficient to enable the block of coal to fall forward; owing to its depth being 5 ft. 6 in.; if it were only 2 ft. cut it would not break; 3 ft. would be a little better, but when it gets to 5 ft. 6 in. the leverage is so great that it breaks by itself and forms a complete fracture at the back of the undercutting.

15777. That is the coal?—The coal. Then the men fill not at the side but at the end (*describing*) of the rib. Then they set fresh timbers board way on.

15778. Still, they are under the block of coal?—No, they work at the end.

15779. Yes, that is under it?—You are quite right; it is under it. But the sprags are in there (*indicating on drawing*).

15780. I am not speaking about the coal but about the stone; there is a series of blocks of stone forming a roof?—Yes.

15781. Is there no danger of that block falling down?—No, we have never found it do so. With this timbering a man sets fresh timber; he is not relying upon timber set a day or two back, as he would in the old-fashioned holeing, he is simply relying upon timbering newly set.

15782. In many cases the system of working is done at an angle to the cleavage cross those blocks of stone, so that one end of the block of stone may be supported where they are taking out the coal?—Yes.

15783. In your system it is exactly the reverse, and there is a series of slips the whole of the way you go?—Yes.

15784. Of course practice is better than theory, but I should not have thought that would be the best?—We used to work in the cross cut at half-end and bord.

15785. So as to keep up the stone?—Yes.

15786. Do you know any colliery where the Leiving test lamps has been put in practice?—No. We had considerable difficulty in observing the two lights.

15787. Do you know whether it has been used at all in practice?—No. We only used it for a few days experimentally.

15788. I know that experimentally it has been done?—I was hoping that it would be improved by using it with a battery.

15789. (*Mr. Cunynghame.*) In the way you were suggesting?—Yes.

15790. Have you seen one of those which you have described, with a platinum wire and an outer globe?—A man brought it out 16 or 17 years ago, and found he wanted 2½ to 3 times the battery power to get a glow through the platinum than through the carbon filament.

(*A man wearing the "Weg" Life Saving Apparatus entered the room.*)

15791. (*Chairman.*) I see we have here now the life-saving apparatus which you are going to describe to us.—Yes. Dr. Haldane has already seen this apparatus.

15792. How much does it weigh?—About 30 lbs. We erected a gallery some years ago like the roadways of a mine, with narrow places in it and filled with noxious fumes.* In that way we tested all the apparatus which had been brought out, and at last I designed this one, and we have been able to do useful work with it, that is, lifting stones, setting stoppings, brattice-cloths, and one thing and another, for 2½ hours, all the time the man being engaged in exertion tests; or supposing a man to be engaged at a gob fire, and having simply to walk backwards and forwards to look at a thermometer, or something of that kind then the man has been in the noxious fumes for six hours with the supply of oxygen that he gets from these two cylinders. There are four essentials. One is that you must have a perfectly tight joint between the apparatus and the mouth. That we get in this way; the helmet is curved over the front of the face against which the india-rubber pneumatic joint presses outwards and inwards it presses against the skin of the face, so that when it is blown up by means of this little pipe the joint ring fills every wrinkle of his face. *This* pneumatic joint is like that used by dentists.

15793. Who blows it up?—An attendant.

15794. (*Mr. Cunynghame.*) Simply by the mouth?—Yes—turning the tap *there* and blowing it up; then you have a perfectly tight joint. The next thing is that being shut off from the surrounding atmosphere, a supply of oxygen is required, and that is contained in these two cylinders, which have a capacity of about 153 cubic inches. The oxygen is put in and compressed to about 1,800 lbs. to the square inch, and with that pressure and that capacity we have proved that we can use it for 2½ hours with exertion or six hours without exertion.

15795. (*Chairman.*) What do those two things weigh?—About 16 or 17 lbs.

15796. That is about 34 lbs. altogether?—Yes, 30 lbs. for the apparatus altogether. Then as the carbon dioxide, or CO^2, is given off, you must have about 2 to 2½ lbs. of some alkali like caustic potash or caustic soda in *this* purifier. Then an appliance to regulate the supply of oxygen, because we find a man uses about six or seven times as much oxygen during exertion as he would without exertion. Then the weight is distributed as evenly as possible over the whole body, head, shoulders and hips.

15797. How do you get the oxygen?—You fill *these* two cylinders—made according to the contour of the body—with oxygen. Then attach a regulating valve, which valve is governed by the lungs, that is to say, if you take a deep inhalation you get a good supply, and if you take a slight inhalation you get less.

15798. It is self-acting?—It is self-acting, governed by the lungs; that is the idea. When the German apparatus was brought out many years ago the man wearing it was occupied in regulating the oxygen supply valve. I thought the explorer should have the use of both hands, and then the idea occurred to me of trying to govern *this* valve by the lungs, and I have been able to do that. This is Beard's reducing valve; I do not wish to take any credit for that. It requires a good valve to deal with 1,800 lbs. to the square inch; I took Beard's valve and supplemented it by an auxiliary valve, which was also another valve of Beard's; so that I got the pressure of 1,800 lbs. on one and about 2 lbs. on the other. When an inhalation is taken it destroys the equilibrium of the second valve, that acts on the main valve and regulates the supply. Whatever oxygen you want comes from *this* pipe into *this* mouthpiece, in which there is a little valve—a little disc—made like *this*, so that it cannot get out of order. Those are the two valves, one to prevent the CO_2 from being re-inhaled. When the man has exhaled the air, it passes over into *this* pipe, over the crown of the helmet and into a vessel which we call the purifier, and the caustic potash is so distributed as to get the largest amount of surface exposed to the vitiated air. Then, having passed through this caustic potash, the regenerated air goes into a receiver, or dorsal bag. With regard to that air, Dr. Haldane experimented to find what amount of CO_2 it contained, and I think I am right in saying that the percentage never got to 1 per cent.; it was 0·5 and less.

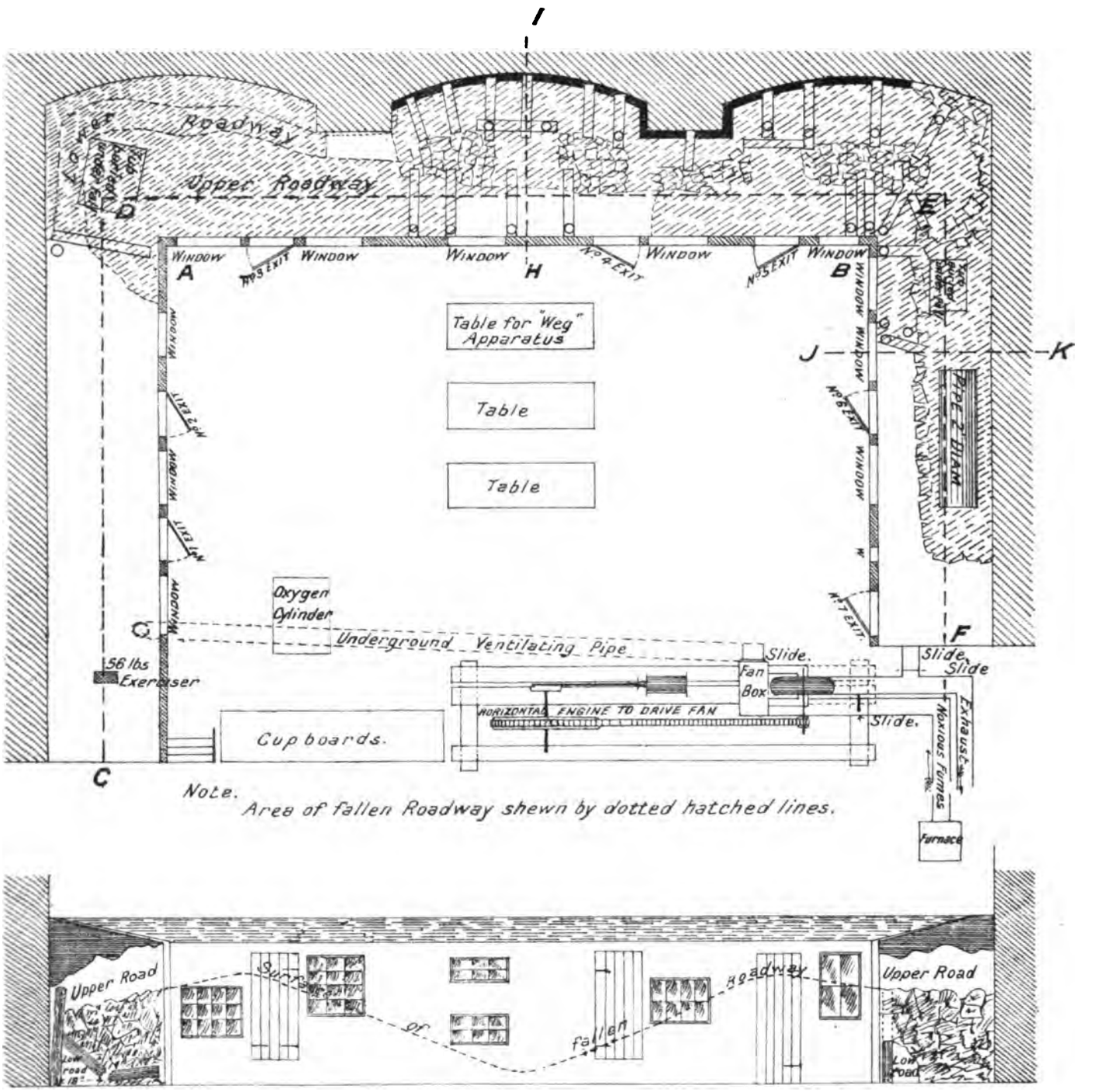
15799. (*Dr. Haldane.*) We have the report giving the figures with regard to that?—Yes. Then what we call the regenerated air comes up through this pipe over the helmet and parallel with the exhaled air pipe, back again to the mouthpiece (*indicating on apparatus*). There are 78 or 79 parts of nitrogen or regenerated air; the exhaled

* See Plate XVIII.

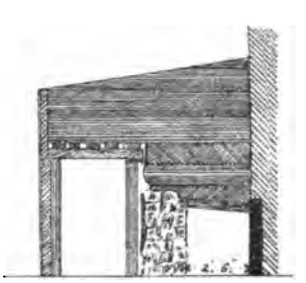
Digitized by Google

ROYAL COMMISSION ON MINES.

THE ALTOFTS EXPERIMENTAL GALLERY.



PLAN AND ELEVATION



SECTION H-I

SECTION J-K

Scale of feet.

INCHES 24 12 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Digitized by Google

Weller & Graham, Ltd Litho. London.

Digitized by Google

air in the mouthpiece was 3·4 per cent. and the oxygen varied considerably according to the exertion done by the wearer. *There* is the battery and lamp; you see the wearer simply hangs the lamp on his chest or front of the helmet, then he has the use of both hands. He has the use of his ears to hear any fall that may take place which will check him in going forward. The eyes are protected by these goggles and kept separate from the mouth. In the German apparatus we found that when the moisture from the mouth was in the same compartment as the eyes it dimmed the glasses and the man could not see; he was simply helpless. The weight of the apparatus is distributed over the head, shoulders and hips. The man with exertion has done 2½ hours' hard work; he has lifted 150,000 ft. lbs. weight, that is 56 lbs. 6 ft. high 466 times; he has stood in the gallery six hours surrounded by a noxious atmosphere, as a man might have to stand supposing he was imprisoned like the men were at Wingate. I was told that in the bottom portion of the mine at Wingate there was fresh air, and the men were obliged to stay, as there was a zone of black damp, or obnoxious atmosphere between the men and the shaft. A man with this apparatus on would have gone through the bad atmosphere to where the men were; he would have seen they were living; he would then have gone back, noticing whether there was any fire on the road, and when he found there was not, he would tell them that he had seen eight or ten men, or whatever the number was, waiting to get out, and there was no fire. Then those men would be released in a few hours probably. But supposing they required to live for five hours with this apparatus on, then by doing nothing, but simply breathing and keeping quiet it would last that amount of time. Then the explorer has with him this horn (*the witness sounded the horn*) in case of danger.

15800. (*Mr. Cunynghame.*) The man seems pretty comfortable now with it on?—Yes. If you wish, we can take the apparatus off and ask him.

15801. It does not give a congested feeling, does it?—No. The supply is automatically altered. If *this* valve fails, he uses *this* little tap; by having this second string and using one hand he would set off at once to the shaft to save himself. We have this bye-pass which makes it quite independent of the non-governing valve, but it means the use of one hand, and he would not be able to help other people. Supposing he got to a sufferer and found that the man was just breathing, he would give him a supply with a portable pipe like this (*illustrating*), letting the oxygen be inhaled by him, and by and bye the man would revive (*the witness worked the apparatus*).

15802. Now what is the weak point in this. I am asking you the question candidly?—One thing is the weight; if a few pounds makes a difference between a horse winning and losing a race, then an extra few pounds on this of course makes it very irksome to carry, and prevents the man doing much useful work. But I do not think it would be quite safe in the first instance to exceed say, an hour and a half for a man to be absent from the pit bottom. We have tested this apparatus for the purpose of seeing what it is capable of doing, and now we propose to cut it down in weight from what you see at present, and to have less oxygen and less other things in proportion. This has all been made at the colliery, but we hope when it gets into the hands of a surgical instrument maker he will be able to make it lighter.

(*Mr. Cunynghame.*) I should like to ask Dr. Haldane what would be the weak point in this apparatus, if any.

(*Dr. Haldane.*) I should say that you want to have this valve very carefully adjusted so as to make sure that the man does not get too little oxygen. I mean you would have to standardise the valve in some way. I do not know whether you have any plan.

(*Witness.*) No. We thought that a man had much better have a continuous supply of oxygen because he must breathe, and then for the extra quantity needed for exertion the valve would work. But we can always give him a certain quantity.

15803. You saw the experiment which we did when you were there; here are the oxygen percentages. The carbonic acid absorption is quite perfect there—the excess is nothing. The oxygen percentage in one of the experiments got pretty low. It got to 10·6?—Yes.

15804. (*Mr. Cunynghame.*) That would be the fault of the valve, would it not?—That was the time when the man was using it for six hours. We have a little nipple in the mouthpiece so that the man by protruding his lips can get a clean suck, as I might call it, of oxygen, that is, when he is going to lift a weight. But in that case he uses as much as 50 per cent. of oxygen, because he is drawing direct from the valve. In case a man wants to use as little as possible he never puts his lips there; he simply gets his proportion from the larger capacity. Since Dr. Haldane was there, a workman named Whittingham has been in the gallery for six hours.

15805. (*Mr. Cunynghame.*) This thing would not be at all suitable for use by men who had not practised with it?—No; it is just like a man who has never ridden a horse, trying to take a fence—he would break his neck; or a man who has never been on a bicycle riding up the Strand. It is simply a death-trap and it needs looking upon with the greatest suspicion until a man has been trained in the use of it. ✓

15806. Are the tubes which are on the back liable to abrasion. I mean, if a man is bending down or going under a place, would he not get those caught?—Well, there is this little shield on the top, but it is not really sufficient.

15807. There ought to be a sort of movable sheath?—There is the corrugated indiarubber under this, but I do not think it is quite enough. ✓

15808. You might get it caught—a jagged nail sticking down from a piece of timber might rip it?—Yes. Then you might have something like a cat's whiskers touching his face so as to give him warning in the dark. We hope by and bye to have a better distribution of the caustic potash and reduce the width and thickness of the purifier case.

15809. (*Dr. Haldane.*) The object of that is to give mobility?—Yes.

15810. (*Mr. Cunynghame.*) But still one would think that a man might have a sort of panoply, like fish-scaled armour, down it, which would be flexible and yet would protect him?—Yes. The form of apparatus which has pipes hanging down prevents full freedom of the head; but, if you notice, this man can easily move his head. If you put your hand at the top of the vertebræ you get on the atlas bone and the movement from the axis bone. We found pipes passing over the helmet a great improvement, to give the helmet and pipes freedom to the head. Then we say to a man "Look to your apparatus and take as much care about it as you do of your heart and lungs." The wearer has gone through an air pipe 18 in. diameter; I think you saw that, Dr. Haldane.

15811. (*Dr. Haldane.*) Yes.—And he regularly goes through a 2 ft. air pipe. But this particular apparatus, which is about the twentieth we have made, I think, has never gone through less than a 24 in. pipe. There is a difficulty in getting these valves to withstand a pressure of 1,800 lbs. *Here* is the valve to show the automatic action which you saw.

15812. I should think that would be very interesting if you have it here?—I thought you might like to see the action of this lung-governing valve (*valve produced*). This is simply a Beard valve, for which he has a patent, I was making one on the principle of a number of multiplying levers; a lever, then a fulcrum, governed by another lever and fulcrum, when I heard about Beard's valve; then I got one, and arranged it as already described. So that you may say the lungs are governed by 1,800 lbs. pressure on the square inch.

15813. (*Mr. Cunynghame*). Can you show how it works?—Yes.

(*Dr. Haldane.*) It works beautifully.

(*The apparatus was worked by Witness.*)

15814. Does it act upon this one?—Yes, it acts upon that one by a passage there leading into this, so that the 1,800 lbs. goes through *there*. In the bellows there are a number of multiplying levers which work with very much less friction than you would have with multiplying levers, as was my first idea. (*The Witness worked the apparatus.*) I am hoping that by and bye, instead of having these two cylinders welded together as they are there, we shall be allowed to have one curved to suit the body; the apparatus would be 3 lbs. less weight.

15815. (*Sir Lindsay Wood.*) What would be the objection to that?—I was told that the authorities were very strict about this, and when you got a straight cylinder like that and tried to curve it there might be a little less thickness on that side owing to the increased length on that side when you drew it out.

The way in which I look on rescue work is this: If an explosion happens and you have an apparatus by the use of which you know trained men can get down to give relief, it

Digitized by Google

Mr. W. E. Garforth.

20 Mar. 1907

is all right; but if we stand at the pit top, as in the old days, thinking that an indication shows the presence of a fire somewhere, and you cannot go down owing to the reek and smoke coming up the upcast, then if at that time half a dozen foreigners came and said: "We have been accustomed to use this rescue apparatus for the last few years," if when they got down they saved some lives, we should feel very much ashamed of ourselves. I think there should always be a party of four, so that if one man is overcome he should have assistance; one man should never explore alone. That is a rule established in the old days.

15816. (*Mr. Cunynghame.*) This tells how much oxygen is left in the cylinder (*pointing to apparatus*)?—Yes; the pressure gauge, we like to get 120 atmospheres—that is 1,800 lbs.

15817. How much is left in this one, for instance. There is not much left?—This is something which I wanted to explain. The Germans had only one cylinder with their apparatus, and in experimental work in the gallery we found it was better to have two, one to explore, and when that was exhausted the second cylinder enabled you to make your way back to the shaft; because it was no use sacrificing another life to find the man lifeless when you got there. By means of this copper pipe which connects the two cylinders you know when your first cylinder is finished it is time to turn back.

15818. How do you know when your first cylinder is finished; what tells you?—By the general feeling of the supply. I am very sorry that the lamp cannot be lit now so as to show you how it works, but Dr. Haldane has seen it alight.

15819. That is an electric light which will burn 7 or 8 hours, I understand?—10 to 12 hours, with two candle power light.

15820. That is the lamp of the future?—I think so.

15821. (*Mr. Ratcliffe Ellis.*) In addition to the offices which you have described as having filled, you have recently been elected President of the Mining Association of Great Britain?—I have.

15822. You have explained what took place at this explosion, and you have also explained what precautions you have taken since to guard against explosions in the future?—Yes.

15823. One thing which you have done is to take precautions against the accumulation of dust?—Yes.

15824. That is to say precautions by keeping it from going down the shaft, and by altering the construction of your tubs?—Yes.

15825. Is there anything else that you have done in that direction; do you remove the dust in a way which you used not to?—No; we do not systematically remove dust.

15826. Do you find that in those two respects, namely, preventing dust going down the shaft and altering the construction of tubs, you lessen the quantity of dust that is accumulated?—Yes, for some of the reasons I have mentioned.

15827. You think you have lessened the quantity in that way?—Yes.

15828. Do you think it desirable that anything more should be done in the direction of lessening the quantity of dust that accumulates by its removal from time to time?—Of course if you can do so you are lessening the risk. I have always looked upon the difficulty, and thought it better to deal with the cause than with the effect—by taking such precautions that you could not have the effect.

15829. Then the other precautions which you have taken are really with reference to shot-firing?—Yes. We use high explosives now instead of gunpowder, as in the old days.

15830. Have you done anything which is not already provided for in the Mines Regulation Act and in the Explosives Orders?—No; I believe the Government have covered everything, and that if colliery people only carry out what the Government have laid down in the various Acts of Parliament and the Orders which they have issued, there would be no need for further legislation. Just in the same way, say, with a footbridge at a railway station: if there is a footbridge over a line and people use it, there are never any lives lost; but if they do not use it, then loss of life will result by being run over.

15831. That explosion which you have described at Altofts was, you think, the result of firing a shot: first of all, the shot being badly placed?—Yes.

15832. But it was through it being fired too soon after two other shots had been fired, when there was a considerable amount of coal dust in suspension caused by the firing of those two shots?—Yes.

15833. Is it necessary to prescribe any interval between the firing of one shot and the firing of another, do you think?—I am hoping the experiments which it is proposed to conduct on the surface will help to clear up that question, or what interval is necessary. I believe that with a certain amount of dust and one shot fired you may not get an explosion, while with a second shot and with the dust in suspension, you may get an explosion.

15834. You think that is a matter upon which information is required to show what amount of time should elapse between one shot and another?—I do. I think it is the only way to settle the controversy which has been going on for the last 20 years respecting the danger of coal dust.

15835. Do you think that now even amongst both men and managers the danger from coal dust is sufficiently appreciated?—It is very much more understood than it was some years ago. I believe every year adds to the list of people who believe in the danger of coal dust, but there are still a very large number of people who say, "I will not believe it unless you have a certain percentage of firedamp."

15836. And one use of these experiments would be as an object lesson to show by experiments that there could be an explosion of coal dust without any gas?—Yes.

15837. You think experiments would be very useful from that point of view?—I do. I think it would be the coping-stone for all that has taken place; I mean the different papers that have been read, the explanations of how explosions have occurred, and evidence given by Inspectors and others as to the facts, &c.

15838. Examination is always made or ought to be made, I presume, before a shot is fired in a haulage road, to ascertain that the place is free from gas and is sufficiently watered. There should be the same examination with reference to coal dust in suspension?—Yes.

15839. There is no express provision at present that that should be done?—No.

15840. Do you think that is a matter which ought to be provided for?—I do. At Ashton we fired a shot and the men were covered with dust a quarter of an inch thick, and some of the officials were not aware of the danger of firing the second shot, which danger would be brought home to them by the suggested experiments.

15841. Do you think it desirable that before any shot is fired in a haulage road it should be brought before the attention of a responsible manager and should not be fired without his permission?—As to that I should not like to say.

15842. That is not provided for at present?—No.

15843. And you have not formed any definite opinion as to whether that is a necessary provision?—I should not like to say that without further consideration.

15844. At your own colliery you have competent persons appointed to fire shots?—Yes.

15845. In what way do you instruct them as to their duties, and what are the precautions which they have to take?—They are called together every week, and dangers are pointed out to them, and they are given certain instructions, and if any risk has been run by any of them during the week it is pointed out to the others, and also the consequences that might result from any carelessness or want of strict carrying out of the Orders.

15846. Are there any written instructions given to them beyond the General and Special Rules?—No. There are certain things that we have found by experience to be necessary, and those are well drilled into them.

15847. I believe it is the practice, no doubt it is your practice, to give the shot-lighter a written appointment?—Yes.

15848. Do you think it would be any use if on the back of that written appointment were printed the rules especially applying to the work which he has to do with reference to shot-firing?—I think that is drilled into him without anything of that kind.

15849. You think that it is not necessary?—I do not think it is necessary.

15850. Did you read the Report of the Wingate explosion?—No, I have not seen that, but I have heard a good deal about it from other people.

15851. You look upon getting coal by a coal-cutter as conducive to safety with reference to preventing falls of roof?—I do.

Digitized by Google

15852. Have you found from experience that that is so ?—As I have mentioned, we have only had one life lost for 3,000,000 tons raised.

15853. From that point of view you look upon the introduction of coal-cutters as securing safety ?—Yes, except that I hesitate to give an opinion upon that because, as you know, I am the inventor of a coal-cutting machine, and I should not like to take this opportunity of advertising it.

15854. But still your experience is that when you do get coal by means of a coal-cutter you have fewer falls of roof, and you can deal with the coal better by a coal-cutter than when it is cut by hand ?—Exactly.

15855. You have an interest in a colliery in Lancashire ?—Yes.

15856. That is a very deep mine ?—Yes ; we are working coal 860 yards deep.

15857. What sort of roof is it there ?—It is a very strong roof, very "lungeous," and after a certain area has been exposed a heavy fall takes place.

15858. Is that a dry and dusty mine ?—Yes, but not more so than some mines nearer the surface. It is a strong coal, not friable, nor liable to make dust.

15859. Could you water the roads in such a mine ?—No : the mine is lying at an inclination of 1 in 3, or 1 in 3½ and if we watered the roof it would break, just as *that* stone which I have produced is breaking up in the tin, with this difference, that it falls and gets on the rails, and when the tubs were going down they would be thrown off the rails. I do not think we could work the pits at Normanton more than two days a week, even if we had orders for six days, if we had falls, as shown by the photographs.

15860. That is to say, the time taken up for the men dealing with the falls would be so great that you could not work the mine more than two days a week ?—Yes. I thought of trying the experiment of watering one of our haulage roads to see how often we should be stopped in a fortnight.

15861. This blue metal which you have brought here comes from Yorkshire ?—Yes.

15862. Is that a fair specimen of the metal overlying the seams not only in your colliery but in a great many other collieries ?—Yes.

15863. You could not water there ?—No.

15864. But could you have watered zones either at Ashton New Moss Colliery or at Normanton, do you think ?—I do not think so, because the place where we should have the zones would be difficult to deal with. Suppose, for instance, somebody asked now, with all the knowledge gained from Altofts explosion, and it having been proved by experiment that a dustless or watered zone would prevent the spread of an explosion, where would you put them, I should say : The weak state of the shaft pillar prevents a zone being put where the greatest amount of dust accumulates now, partly from droppings from the tubs, what comes down the shaft, and from dust accumulated in other ways. As regards a dustless or a watered zone in-bye there would be some difficulty until the overlying strata became settled. The difficulty in getting the dustless zones is this——

15865. I am speaking about watering for the moment. You could not water the road in its natural condition at either one place or the other ?—I do not think we could.

15866. Then if you had to water so that it should be effective, you would have to have a specially prepared area in that part of the road ?—Yes.

15867. Would that mean building it with masonry ?—I do not know. I have seen the strongest stone crushed up like dust.

15868. Could you put such masonry at Ashton Moss Pit ?—No, we cannot. We use such a large proportion of timber, so that when the weight comes on the weakest goes first, that is the timber, which saves the stone, and so gives us a two years' longer life.

15869. You do not approve of a regulation which would make it compulsory for all mines to be watered ?—I do not indeed.

15870. (*Mr. Cunynghame.*) Do you mean not even a compulsory regulation to water by zones ?—Well, I do not see how we could carry it out.

15871. (*Mr. Ratcliffe Ellis.*) Therefore in these two mines which you speak of—and they are not exceptional—you say they are characteristic mines ?—Quite so.

15872. You say you could not prepare a zone for watering which would stand ?—No.

15873. Except at very great expense, I suppose, by being constantly repaired. Now will you tell us what is the temperature in your Ashton Moss Colliery at that depth ?—It is from 78 deg. to 80 deg. in the Ashton New Moss Colliery, that is at about 860 yards deep ; and in the Normanton Pit it is about 76 deg., at 500 yards deep.

15874. If you were to adopt the system of watered zones it would make it much more oppressive for the men in working ?—Yes—they cannot breathe moist air with the same comfort.

15875. Therefore watering evidently, either in zones or on the roads, would be impracticable in that class of colliery which you have spoken about ?—Yes. In the lower mines we had complete saturation. That was often tested with the hygrometer.

15876. With reference to clearing dust away and having dustless zones, do you know at present, or does anybody else quite know, how much dust you can leave uncleared for it to be harmless ?—No ; that is one of the matters to be settled by the suggested experiments.

15877. But do you agree with others that taking the ordinary road you could clear it of ordinary dust, that is to say, that you could not take all the ordinary dust away ?—No, it would be impossible.

15878. Even in a zone ?—Well, I have not seen a zone made like Mr. Fowler mentions.

15879. Before we go to the question of an artificial zone, I will put to you a zone for some distance along the ordinary road ; you could not clear it of dust sufficiently to make it non-dangerous, you think ?—No.

15880. Take Mr. Fowler's case ; he has artificially constructed zones, I believe—he has them built ?—Yes.

15881. Would there not be the same difficulty in building a zone for clearing from dust as there would be with a watering zone ?—I should like to know more what he does, and more about the apparatus which is now used for carpets, and that sort of thing—a kind of exhauster of dust.

15882. You think that should be further inquired into ?—Yes. I was agreeably surprised at the results which Mr. Bonser gave me as to the large area he could deal with in a certain time, and at such a low cost, with the cleaner.

15883. You think that is a matter as to which the Commission should obtain further information ?—Yes. For instance, supposing the experiments were carried on, we should then have the dustless zone, and we should get to know the best apparatus to use, and the number of superficial feet that the apparatus would clear, and the cost.

15884. In cases where it might be impracticable to have either watered or dustless zones, I suppose you would look for safety to strict regulations as to shot-firing ?—Yes—that is the cause ; we must always look at the cause first.

15885. In your view, if the present Regulations are carried out are they fairly sufficient ?—That is so.

15886. (*Mr. Smillie.*) How far below the top of the coal is this stone ?—In the lower seam at 500 yards deep. That piece which is furthest away from me (*pointing to sample of stone*) exists for about 10 yards ; but the other piece, which is from the pit where we had the explosion—that is the Silkstone—is about 12 ft.

15887. Right from the top of the coal ?—Yes.

15888. Do you think that those collieries which you are connected with and which you have been speaking of chiefly to-day, are absolutely free from danger of explosion ?—I think so.

15889. That is to say, providing the Mines Act is carried out ?—Yes. I believe I can go over any part of them with an open flaming light.

15890. Have you had any serious outbursts of gas in any of your pits ?—No ; we have never had any, because our system of working has been longwall, packgate, and although there is a little seam varying from 5 to 12 ft., when the pack becomes consolidated the superincumbent weight is sufficient to break the ground. By draining the gas regularly we never had any outbursts.

15891. I suppose your statement, that if the provisions of the Mines Act are properly carried out there would be very little danger from explosion, would really apply to your own collieries ?—Yes.

15892. Would you say that that would apply to all the collieries of South Wales ?—I do not know sufficient about South Wales to express an opinion.

Digitized by Google

Mr. W. E. Garforth.

20 Mar. 1907

15893. In making the statement that in your opinion sufficient legislation, if it is carried out, has been passed, that applies only to the collieries which you know in Yorkshire and Lancashire?—Of course; I have been down pits in South Wales—Harris's Navigation, which is about the deepest—and I know something about dust.

15894. Have all the serious explosions during the last 20 years arisen from shot-firing?—A good many have. I could not say the proportion.

15895. Do you know of any serious explosion which has arisen from the ignition of gas at the coal face?—There used to be some very careless things done. A good many people have been burnt by explosions from fire-damp when open lights or candles were used.

15896. In safety-lamp pits where every precaution has been taken, supposing a serious explosion has taken place within the past five years at the coal face, which was initiated by an accumulation of firedamp, but which ultimately became a dust explosion, would you say that the present Mines Act provides for a case of that kind?—I do say so.

15897. Supposing it is proved that provisions of the Mines Act in that case were carried out, do you still say that we do not require any further provisions?—I do.

15898. I suppose you recognise the possibility of an explosion of firedamp initiating what might be a serious coal dust explosion afterwards?—Yes. I believe the experiments in an iron gallery will prove that, and other points, when they are carried out.

15899. In a colliery with such extensive workings as this colliery of Altofts, what would you propose in order to prevent an explosion which might be initiated at the coal face being carried right along the intake air course as this explosion was? Have you any proposals to make to prevent the continuance of that explosion?—I have already dealt with a number of precautions that we take now. I have often put that question to our officials. I have said: "Now assume that we have all the information gained by the Altofts explosion, and another explosion may take place at the same spot, where would you have your dustless zones?" Well, we should say somewhere about *here* (*pointing to plan*). That is near the pit bottom and that will serve a double purpose. Had there been a stone dust zone there, and assuming that it had been of sufficient length to reduce the explosive blast, like there was at the top of No. 1 chain, as already described, the explosive blast would never have gone up *there* and caused such damage (*pointing on plan*). All *those* light patches represent falls, as I think I have mentioned.

15900. Yes; but as a matter of fact, you say now that in your collieries it is impossible, or practically impossible, to have watered zones?—Yes.

15901. Consequently, if you had an explosion now at one of your collieries, assuming that there was sufficient dust on the crown, sides and bottom to continue it, there is nothing now to prevent it traversing the whole of the main intake aircourse?—No; wherever the coal dust existed it would be like a train of gunpowder.

15902. Can you suggest anything which would enlighten the Commission as to what might be done to prevent it in collieries where watering either in zones or generally is impossible? Have you any alternative course?—No, except to strictly carry out the law as it stands and then see what can be learnt by the experiments, and if they show something different to the opinion which I have given, of course, fresh suggestions would be made. But at the present time I could not suggest anything better than those I have already mentioned.

15903. With regard to the lamps, can you tell us what is the custom; do the workmen pay for their safety lamps, or does the employer, in your experience, bear the whole cost?—The coalowners bear the whole cost.

15904. (*Dr. Haldane.*) Can you give us any idea as to what is the probable pressure developed in a dust explosion in a colliery?—I could not. But if safety valves were placed at different distances they might serve the same purpose, like those experiments at Altofts; until they were introduced we had wrought-iron girders damaged and rails 70 and 80 lbs. weight to the yard simply twisted in all shapes.

15905. (*Mr. Cunynghame.*) But then you did not get a true explosion. The Inspectors of Explosives doubt whether they have ever had a real explosion in any of the Woolwich instruments or anywhere else—that there has been a lick or a flame, an ignition, but when we get a real explosion it will surprise us?—Yes, unless you get a certain amount for expansion in the sides of the tube, like the underground roads leading from the main haulage road. Except this, you notice that when the explosion took place on the west chain road, it ran along the trail of coal dust up No. 1 haulage and other coal dust roads, it had a chance of getting down Roper's drift and the main return, which is a road with 70-ft. area (*indicating on Plan*), but instead it followed the coal dust and died away in stone dust. It had many roads in which to expand. In the same way we have these safety valves for the purpose of taking away the strain upon the tube. Cotton dipped in some spirits would show whether the flame caught it at a particular point or after it had got a certain distance.

15906. (*Dr. Haldane.*) But supposing you let off the pressure, it seems to me that it would be a very doubtful test of the efficiency of the wet or dustless zones that you would get in a gallery?—But if you have a flame rushing along a haulage road at a speed of 80 miles an hour, which Mr. Galloway and I estimated was the velocity of the explosive blast at Altofts, and within a few hundred yards from the last signs of destruction and coal dust, there was not the slightest particle of damage, then we are hoping that the watered or dustless zones will do the same thing, and that the flame will not issue.

15907. But I think in order to test a dustless zone or a watered zone you want to get the full pressure of the explosion blowing the dust and flame through the dustless zone?—Yes, that is what I mean.

15908. That is to say, I do not think you want safety valves and things beyond; I think you want to let it do its worst?—I am assuming that the explosion takes place, and the blast gets a certain length along the tube, it is of such violence that we can see it, and probably everyone will admit that such violence would cause the destruction they have seen whilst recovering a mine after an explosion. Then you attach to that length of tube your watered zone tube, at the end of which, instead of finding the flame issuing from it, it is simply hot air.

15909. Quite so; only I think to test the dustless zone you want to provide your gallery strong enough to resist the maximum pressure of the explosion. Do you not think so?—I do.

15910. Therefore you do not want to have safety valves?—No. It will, I imagine, be about the same as the tests of wrought-iron girders when they were first made years ago; one part was very strong, but another part was weak; so they put another batch on and a piece of tee iron there, &c., and experiments were conducted until all parts of the girder gave out together; so in the same way this tube will be very different after we have experiments with it for two or three months; there will be branch tubes, openings, and bands of tee iron and channel iron to strengthen the tube where required.

15911. That would be a very expensive business compared with making it strong at the outset. I want to know what pressure the section of a gallery which you have had put up for experimental purposes would bear—that is internal pressure. Do you know?—I do not.

15912. You have not calculated that?—I have not.

15913. Some indication of the pressure might be got from the symptoms of men who have been exposed to the pressure of an explosion. You mentioned a man and a boy who were in a lamp cabin at the pit bottom in the Altofts explosion?—Yes.

15914. Do you happen to know whether they were deaf after the explosion; were the drums of their ears ruptured?—I am glad you have mentioned that because that lamp man is still in our employ, and I have often asked him what his sensations were, and he has always repeated the story which I have mentioned just now. He always wears a little cotton wool in both ears, but I will ask him when I see him to-morrow.

15915. Can he hear quite well?—He can hear.

15916. I wondered whether he sustained a rupture of the drums of the ears in the explosion, because if he did not, the pressure cannot have been very great.—The boy has turned out a strong healthy man, and at the time of the explosion I should think the boy was about 17. I was the one who lifted him into a kind of sack, because we had so few men down, and as I lifted him all his skin came off in my hand.

15917. That is to say, the epithelium was loosened?—Yes.

15918. His arm was not permanently injured by that?—No.

15219 I have seen that before, and I have had occasion to notice it. But it is with regard to his ears that I should

Digitized by Google

like to know, because that is a good indication; a sudden high pressure will certainly rupture the drum of the ear, and if this man was not deaf after the explosion, it shows that the pressure cannot have been very considerable. —Yes.

15920. I have never heard of a man exposed on or near the track of a colliery explosion being made deaf by it.—This man certainly wears wool in his ears.

15921. There may be something in that; he may have had some injury?—Yes; I will find out.

15922. With regard to falls of stone, and your system of working the longwall face, you attribute the small number of accidents chiefly to the straight face which you keep?—Yes.

15923. And that of course you are enabled to do by coal-cutting machines?—Yes. You can understand that if we have a straight cut, as straight as this table, then like cutting a piece of cardboard with a ruler, it produces a straight break, that means straight timbering; and if you have nothing but straight lines you can get it into systematic timbering, or the same work day after day and month after month. But if, instead of that, you have an irregular cut, it produces an irregular break, which means having your timber set irregularly. You can never get it systematic when it is different from fall to fall.

15924. Is there any virtue in the face being in a straight line? If it were in a regular curve do you think that would answer as well?—Well, commercial reasons come in then; the block of coal which stands knocking about in transporting or in shipping is the piece which has only eight points to break, whereas if it is jagged you have 12 or 14 points, and that coal makes a larger percentage of small coal.

15925. I think your statistics of accidents from falls of roof are a good deal lower than those obtained at Courrières with their system?—Yes. I saw that system in France when it was first introduced, I think about 1881 or 1882, and I consider that we have far less timbering, for the reason I have given.

15926. But you have actually got better results—fewer accidents in proportion to the number of men employed?—Yes. In that mine we have not had a single man killed at the coal face during the 8½ years that it has been working. I say that with thankfulness and not boastfully.

15927. (*Mr. Cunynghame*). It has been suggested to us that watering, say zone watering, should be made compulsory—perhaps with exceptions, but still compulsory. I should like to hear your view upon that; would you condemn all forms of compulsory watering, or do you think that in some cases with proper exceptions it might be admissible as a new Rule?—I do not think it ought to be made compulsory. With all respect, I think it would be unreasonable to make it compulsory upon all mine-owners.

15928. Even with exceptions?—Yes.

15929. But are there not some mines in which it would be really a duty to water; are there not some mines in which zone watering could be done, say, without too great danger to the roof and sides, and in which it would be a duty to see that it was done?—I think the inspector should take all the conditions into account and that he should enforce what he thinks would lead to the safety of the pit.

15930. You are of opinion that in certain mines it is desirable that there should be watering and that it should be compulsorily done?—That is answered by the fact that they are doing it at the present time.

15931. (*Chairman.*) I should like to call your attention to the evidence which has been given before us by Mr. Blackett; he appeared to think that one means of stopping an explosion would be a door which might not be strong enough to resist it, but supposing there was a door which was not strong enough to resist an explosion but which was blown out by the explosion, then the flame would instantly go through the door much faster than the current of air, which would be more or less checked by the blowing down of the door, and the consequence would be that, although the zone beyond might be very dry and dusty, still there might be no explosion?—No, I have not that idea. When you have once got the gallery I think it will admit of a number of tests being carried out without any extra expense, and that might be one.

15932. His theory is that, although a door might not be strong enough to stop an explosion, and the explosion might be extremely violent, still, in the great majority of cases, he believes you will find that a door would be sufficient to stop an explosion, because the result would be that the flame would go at a great pace immediately through the door as it is blown open, but that the gust or blast of air might be more or less stopped by the door. That the flame would go through the dustless zone without any blast; that is to say, that it would precede the blast?—Well, had a door been *here* (*indicating on Plan*) that door might have resisted the explosion soon after it had taken place, but I do not think 20 doors would have resisted it at *this* point, because it had got a fresh supply of downcast air, and there was evidence of great destruction, as I have mentioned.

15933. The point is that even if the door was not strong enough to resist it, and even if you had the door blown out and the flame of the explosion carried on, still, the flame going on in front of the current of air, there would be no current of air to raise up the dust in time for the flame to lick it up?—I think that is pure theory. I can mention certain conditions in which it would be simply swept along.

15934-5. Mr. Blackett does not say that it will operate in that way always, but he thinks the chances are that it will?—The difficulty is, where can you place your doors; you cannot place your doors where the strata is crushing or where you get your first dust.

15936. But you do not yourself think that there is a great deal in it?—No. I shall be very glad to read his evidence and to consider it.

15937. (*Mr. Smillie.*) If you have a doorway in your main intake aircourse it ceases then to be your main intake aircourse and it is shut off?—Yes, it is shut off.

Mr. Henry Stevenson, called and examined.

Statement of Witness.

15937A. I am Agent and Manager under the Coal Mines Regulation Act, of Linby Colliery. Previous to the year 1900 I had a long experience of explosives and their uses. Linby Colliery is one of a group of five collieries situated in the Valley of the River Leen in Nottinghamshire working the top hard coal, these collieries having together an output of two and a-half millions tons per year.

(1) I represent the Leen Valley Coal Owners' Association. Linby Colliery, using two shafts, turns two thousand four hundred (2,400) tons per day of 8½ hours winding. The present output is slightly reduced owing to natural causes. There are 5¾ miles of haulage road with two lines of rails and worked by endless ropes, 10 miles of road worked by horses, and 9½ miles of airways through which no coal is brought. A total of 25¼ miles of roadway. The haulage engines in the mine are driven by compressed air. The mine is dry, and there is dust. Safety lamps are used, but as a precaution and not from necessity. No explosive is used in either the coal or the stone. It is not possible with present information to classify any mine as dusty. There is the same difficulty in comparison between fiery and non-fiery mines. There is no standard fixed to measure fiery or dusty mines. In the Midland district only one explosion has been caused by dust, and there are some to-day who question the finding of the Coroner's Jury. The dust in the mines is not of the same composition in all parts. Bind and other substances, through friction, will enter largely into its composition. I put in an analysis of the dust taken from various places in the colliery.

(2) In the finding of the Coal Dust Commission great stress was laid on "blown-out shots." It is not every shot or every "blown-out" shot that causes an explosion. There is an unknown something in one shot that produces the start of the matter leading to the explosion. I instance Camerton and Timsbury where shots had been fired for a number of years, and some one shot, from some cause or other, produced an explosion. In Mr. Hall's experiments, the dust from the Radstock series

Digitized by Google

Mr. H. Stevenson.

20 Mar. 1907

could not be fired by his tests. There is ample ground in this instance alone to ask for experiments or exhaustive inquiries to be made as to the character and cause of dust explosions. It will be found that the propagation of the disturbance due to shot-firing or other causes will play an important part. As, for example, vortex rings.

(3) The Courrières Colliery cannot be compared with our mines. Upon my visit to No. 6 colliery, the coal I saw was different from any that I have ever seen in the Midland Counties or even in England. The beds have been much folded, contorted, and even inverted, and this movement appears to have taken all the life out of the seams. The coal is like blacklead in consistency, and can not only be kicked out by the foot, but even scratched down by the hand. I put in a sketch plan of a working place showing an open space standing on timber, 30 ft. by 39 ft., where the timber was covered by fine coal dust.

(4) In the German mines, holes are drilled in the solid coal, and water at a high pressure is forced in for some considerable time before the coal is got down in order to reduce the dust. Again, Courrières may be a dust explosion, but it may not be from shot-firing. The dust made upon our longwall working face is not in sufficient quantity to foul the air current. There is little or no dust from our loaded trams. All coal is loaded by hand, no screen or shovel is used. Slack should be the same. The system of fast-end boxes would be useless through the constant variation in the thickness of the seam.

(5) Trains running at a high speed, that is tens of miles per hour, main and tail system or inclines, will raise some dust and that will be carried away by the air current, but it is not generally so in our mines, and with our slow moving system there is practically none. In the screening of coals, some will make less dust than others, and this also will be influenced by the type of screen. That the quantity of dust passing down the shaft from the surface is slight is shown by the fact that the pit arches and incline heads were whitewashed in the Autumn of 1905, and are in a good clean state yet. Wagons, as mentioned before, are no serious danger with us, and the watering of loaded tubs would be injurious to our coals.

(6) In any regulations to move screens, regard must be taken to the circumstances. As for instance in my own case, before doing so I should have to break the terms of a lease, deflect public railways, public roads, move a church and take part of a church yard. These difficulties would render the regulations almost impossible to carry out. The conveyance of the dust from the screen by fans must remain a question of degree.

(7) I have officially in the course of my experience had control of nine of the coal seams at present worked out of the 13 working in Nottinghamshire and Derbyshire (that is excluding South Derbyshire and Mountain Seams). From that experience I am confident that no sides and roof in these mines will stand the application of water. That it may not be a matter of personal opinion only, I have had various lengths of the roof and sides of roads watered, and they became so dangerous that they had to be closed. The length watered had stood without timber for years until this application of water.

(8) If the watering of the sides and roof is adopted, either some of the mines must be exempted or in a short time they will be closed from the effect of the water. The exemptions must be greatly in excess of the number of watered mines. This renders the system of little value. Again, exemption will not be given by the Inspectors of Mines. They will not naturally bear the responsibility and will be forced to arbitration. Before a mine is closed by watering, if exemption is not allowed, injuries from falls will be increased by a very large percentage. It is impossible to give an estimate of what this increase will be. As a Manager, I view with alarm such increase and the responsibility involved. In the five years from 1901 to 1905 inclusive the total number of deaths and injury by gas is 47 (and it must be noted that explosions by gas in flues of boilers at the surface are included). For the same period, the total number of accidents (fatal) and injuries from falls is 1707. It will be noticed that the total fatalities from falls are 226 and non-fatal 1481. Many injuries from falls result in simply slow lingering death, constant pain, without the enjoyment of life to the injured, and to water the mines would increase this class. Evidence has been given that watering should be compulsory in all mines working with safety lamps.

(9) In cases where lamps are used as a precaution only, in order to evade this restriction, lamps will be withdrawn and it will become an open light pit. Again, should all mines require to be watered, those not at present using explosives would introduce them to meet the increased cost of the regulation. At present the dust upon the floor is dealt with by watering heavily, and the dirt and dust filled into trams and cleared away, and this is all that is necessary for all practical purposes.

(10) The air current at this colliery under normal conditions is capable of absorbing and carrying away 125 tons of water in 24 hours. This water would largely have to be bought, as there is not a sufficient supply upon the field, and the drain upon the local water company at the period of the greatest demand would lead to the colliery being closed for the lack of supply of waste water. This would also apply to other collieries in the district. Providing zones, wet or dry, is very much like the old story of locking the stable door when the horse is gone. The very important fact is overlooked that there would still be the afterdamp to contend with. At present there is no evidence as to length, height, and direction, sufficient to prevent any explosive force passing through a road. It would act something like a flame passing through a gun barrel. For example, the Blackwell Colliery explosion flame went through an archway and turned at an angle of 50 degrees.

(11) This is a subject which would also be included in the experiments that you are pressed to recommend should be undertaken. As to the effect upon the health of men working in a saturated atmosphere at a high temperature medical experts must decide, but it is certain that it cannot be but at the loss of some amount of physical energy.

(12) Another danger will manifestly be increased, *i.e.*, spontaneous combustion from damp clunch and moistened pyrites at the working face. Sweeping the dust from sides of timber of roads is much like the dirty housemaid who whisks the dust from the centre of a room and lets it settle in the corners. Collect and remove the dirt from floor of roadways before it is ground into dust and the timbers will be clean, following this up with restrictions on shot-firing; then there would be nothing to fear from dust explosions, as far as the Midland districts are concerned. Any substance or liquid used for sprinkling upon dust must be such as not to be injurious to horses or men when walking or working amongst it. Upon the question of the use of salt, the Dumb Creatures League presented a petition to the London County Council asking that salt should not be used with snow as it caused pain to the horses.

(13) As at present known, the causes of all the explosions are either gas or a "blown-out" shot. All shots, whether the pit be candle or lamp pit, in my opinion, should be fired by an official who should hold a certificate after an examination suitable to his occupation. The Explosives Order should be extended to include all main horse haulage roads. Any shot on the main road should not be fired except by a written authority signed by the under-manager and countersigned by the manager.

(14) A safety lamp should be used of a power not less than the Hepplewhite-Ashworth-Gray, burning colza petroleum illuminant, for finding the smallest quantity (not percentage) of gas present. Upon the question of certificates for shot-firing there is the danger of a manager being suddenly called upon to work under the Explosive Order and his men are utterly unqualified to take over the permitted and electric firing system of explosives.

(15) I had the unfortunate experience within a few days after taking charge of a group of collieries of having to train a staff of men in testing and firing, but the great trouble was repaid by the success of the system and the confidence of the workmen in carrying out their duties.

15938. (*Chairman.*) You are the agent and manager under the Coal Mines Regulation Act of Linby Colliery?—Yes.

15939. Previous to the year 1900 you had a long experience of explosives and their uses. Where have you had experience, in the Linby Colliery or in other places?—Boythorpe, near Chesterfield; a colliery that is now closed. The Butterley Company, the Pinxton Collieries; they are all in the Midland Inspection District.

Digitized by Google

15940. Are you acquainted with any other district?—Yes; I served my articles to a firm of engineers at Sheffield and Wakefield, and there had experience from Barnsley to Tamworth.

15941. In your mine you say that no explosive is used in either the coal or the stone. You have nothing to tell the Commission with regard to shot-firing?—I am speaking for the Leen Valley Collieries. My workings, or rather the Leen Valley, are the first collieries in that district to go through the new red sandstone. I should say that my workings are furthest to the east of any colliery in Nottinghamshire, and the nearest to the German Ocean. It is said that the coal goes from us to the German Ocean, and I say that we are working as far to the east as any colliery. Some collieries do not fire, similar to myself, any shots. There are five collieries. Others fire a few, probably 10 in the month, but they are such shots that if any restriction is placed upon the shot-firing they will abandon the firing. It is not a necessity.

15942. If they were not allowed to do very much as they pleased with regard to the method in which the shot-firing is carried out, you say they would give it up altogether?—They are firing now under the Explosives Order, but if there is any watering or any further form of restriction placed upon them they will be able to abandon them.

15943. Among other things that you say ought to be considered with regard to dust explosions in connection with shot-firing are vortex rings. Have you gone into that question at all?—I have not as a professor gone into it, but vortex rings—I do not for a moment doubt that it is a question that should be experimented with—are a very important factor in some shots. I will give you an instance: I have not seen many, probably half a dozen in my life; steam coming out in a ring like a lifebuoy from a shunting locomotive. You will notice that some ascend steadily. Others ascend steadily, but rotate very rapidly with horizontal motion. With a ring of that description dust would be licked up in front of any flame with tremendous rapidity.

15944. I know Prof. Galloway has called attention to the vortex rings, but I do not think that anybody else has called our attention to them. You have not gone into the matter scientifically, I understand?—No.

15945. You suggest sampling different kinds of coal dust, and you have taken samples yourself?—Yes, and I should like to add to that that chemical and microscopic examinations of the various coal seams should be undertaken with a view to finding out the composition of the vegetable life before the coal seam was deposited. I think that you will find that club moss, the spores of club moss, and the fern will play an important part in the difference between the very fiery seams which you have in Wigan and the seams, say, in the Forest of Dean, where gas is never found. Instruments are too expensive and the time too great for individuals to take up that research; I do not believe that it has been taken up so far. I am a member of the Iron and Steel Institute, and that body used the microscope in conjunction with chemical analyses upon various samples. Some members of this Commission are probably not aware of the amount of work that is done by the microscope in assisting the chemical part. I should like to pass this round. Those are only a few out of some hundreds of slides prepared in determining that question upon iron and steel. That is a Paper written by one of the Carnegie research scholars. You will find in the mechanical portion hundreds of tests, and there are hundreds of tests of the microscope, which were never published.

15946. Then you talk about the dust coming from the screens, and say that that would be influenced by the type of screen. Have you anything to say with regard to the type of screen you think desirable in order to prevent the dust going down the pit?—We do more picking by hand. If you have mechanical sorting of coal, that is sorting to size, with a lot of vibrating screens that will make a considerable amount of dust.

15948. Have you anything to suggest as to the way in which the screens should be constructed with a view to preventing the dust getting down the pit?—The screen must be adapted to the coal. We do not sell to size; we sell to quality. Our seam is composed of hard and soft coal, and there is no mechanical arrangement made at present that will select soft coal from the hard coal. We must hand pick it. You will see from the photograph that the pit top is quite open.

15949. You do not object to the pit top being open, although a certain amount of dust must go down if it is quite open?—No, the tipplers are so far away from the pit that the dust is blown away.

15950. Supposing they are quite near, that would be a danger to be guarded against?—Not as far as screening is concerned in the district for which I am speaking.

15951. Supposing the screen happens to be close to the pit, what would you do then? I know that it is not in your case, but supposing it was. Would you have anything in the nature of fans to take the dust in another direction, or how would you prevent the dust from going down the shaft?—If it is found that dust goes down it is a serious item; it must be dealt with at the top by some method of collection. As far as we are concerned, in all our mines dust is not a question at the pit top. It is not in the coal to start with.

15952. (*Mr. Smillie.*) You do not load any small coal in the pit at all?—No, except by the men improperly loading, a matter which comes under the Coal Mines Regulation Act, and is dealt with by means of fines. All should be picked up by hand.

15953. (*Chairman.*) You say that you have had various lengths of the roof and sides of roof watered, and they became so dangerous that they had to be closed. In your mines, at all events, you could not have universal watering?—It is impossible to water the sides or roof.

15954. Anywhere?—Anywhere.

15955. You could not have watered zones?—That would have the same effect. As far as zones are concerned, supposing it were compulsory, where should I fix the zones? I found out that in trying to fix them that I should have to have a zone to protect a zone.

15956. What do you mean by that (*the witness explained to the Chairman on a plan*)?—Then as far as a zone is concerned there is another danger? I have seen it suggested that they should be plastered and so forth. How is it possible with plaster over the side of a road for the deputy to examine that road? Sounding upon that skirting board or that plaster would not tell you the state of the brickwork, or whatever is, at the back.

15957. So that you say the plaster would be a snare. You would not be able to find out what was going on on the roof or sides?—We have great falls of side often and also roof, but with a plaster in front I do not see how we can tell. It is held by our Inspector that every fall of roof or side is a breach of the Coal Mines Regulation Act.

15958. Sometimes there may be an unavoidable fall of roof or side?—He does not admit that.

15959. Then you say that another danger from watering is spontaneous combustion from damp clunch—that is, fire clay and moistened pyrites?—Yes, we have pyrites in the coal. We have pyrites to an extent in the dirt above the coal. Another word for spontaneous combustion is gob fire. Damp is one of the things which we have always held is a starter of gob fire.

15960. Then you talk about substances or liquid for sprinkling upon dust. Have you gone into that?—No, and, unfortunately, I have mislaid the print which calls attention to what the Dumb League says.

15961. That is as to the salt?—Yes, any quantity of damp salt would be injurious to the horses' feet; and also as far as the Compensation Act is concerned, which I take it you have nothing to do with, if we had a lad with a crack in his boot and a sore on his foot, and the salt worked into the sore, we should not gain by that.

15962. You say the cause of all explosions is either gas or a blow-out shot. Blown-out shots are very rare now, I imagine?—Probably, but I might refer to the recent case at Wingate.

15963. Then you say your remedy would be, in the case of shot-firing, that no shot should be fired except by an official who should hold a certificate after examination suitable to his occupation. Would you also suggest that a manager or under-manager should, in every case where a shot is fired in the main haulage road or in a dangerous part of the mine, authorise the firing of that shot?—I should say both manager and under-manager. I should say for a shot upon a main haulage road permission should be given by the under-manager and manager, and if the manager is absent, it should be countersigned by the under-manager.

15964. If they are both there they should both concur?—Yes.

15965. And if only one of them happens to be available one of them must give it?—Yes, but I should point out that by the Coal Mines Regulation Act the under-manager

Digitized by Google

Mr. H. Stevenson.

20 Mar. 1907

in the absence of the manager is responsible. If the manager is absent, he should countersign for the manager.

15966. You say in your Statement, "countersigned by the manager." If the manager is not at hand you would allow the under-manager in fact to do duty for both ?—Yes, naturally. Supposing the manager is away on his holiday, for instance.

15966*. (*Mr. Cunynghame.*) I think if I heard you right that you recommend certificates for the shot-firer ?—I will tive a case in point. A workman on the coal face, holding a second-class certificate, got an appointment in another county as an official. He went to that appointment. What he said or did not say I cannot tell. He started with a battery and a cable as a shot-firer but he had never seen a shot fired in his life. The manager is responsible for appointing a competent person, but I ask, assist the manager in the same way as you assist the owner or agent in appointing his manager and under-manager, not, necessarily an examination for ventilation and a number of other things, but an examination suitable for the shot-firing.

15967. You say that he should hold a certificate. Who would grant that certificate ?—I should say a board of examiners.

15968. There should be a board of examiners who should grant certificates for shot-firing ?—I do not say that a manager, although he is by the Coal Mines Regulation Act held to be the person to appoint these people, should hold an examination for certificates. How many certificates or testimonials are given by managers to pupils who go before the Board of Examiners and are stated to be competent persons to manage a mine, and the Board refuse to pass them. They are not the best judges.

15969. (*Mr. Ratcliffe Ellis.*) Are not those certificates as to character ?—No, competency too.

15970. (*Chairman.*) With regard to safety lamps you say that they should be used of a power not less than the Hepplewhite-Ashworth-Gray, burning colza petroleum illuminant for finding the smallest quantity (not percentage) of gas present ?—Yes.

15971. Colza oil being the most sensitive ?—No, you will see from a section I have here that it is not the most sensitive. I suggest that a standard should be made and from that managers can draw their own conclusions.

15972. The managers should have access to this standard and then they should please themselves as to what lamp they employ. Is that it ?—The standards are fairly well known but if you fix a standard they must work to that standard whatever they use. (*Witness produced lamps.*) That is the Gray lamp that has been adapted. It feeds from here (*indicating*). The air passing down these tubes enters the lamp here. This is the Marsant (*producing another lamp*). The Clanny and other lamps feed from the same point. A fair layer of gas can be at the roof without this lamp being influenced. If you examine a break, this lamp going in so many inches and a strong current of air passing underneath, it is not detected. I am speaking of bodies of gas when the whole current is charged, but I am testing for small quantities. If that is passed into the crack feeding from here you find it directly.

15973. (*Mr. Ratcliffe Ellis.*) You cannot test for gas with that in holes in the roof ?—No.

15974. If there happens to be some gas in the return airway—— ?—You can find it with that as well as with this.

15975. (*Chairman.*) Is that the Hepplewhite-Ashworth-Gray ?—Yes.

15976. Is that what you recommend ?—Yes—I do not recommend it, I think I say in my report "of not less than."

15977. "Of a power not less"—you mean illuminant power ?—No, for detecting. Those tests you have are with this lamp with different illuminants.

15978. (*Mr. Ratcliffe Ellis.*) What exactly does that mean (*indicating on section*) ?—That is a reply based on questions that were asked of several of the inspectors—"Would you not if you found a cap condemn the current ?"

15979. Those are the caps you find ?—Yes, those are the caps.

15980. With different lamps ?—No, with this lamp but different illuminants, alcohol, benzoline and colza.

15981. Under the same conditions you find these different caps using these different illuminants ?—Yes, but I may say as far as finding caps is concerned—you find further on in my evidence I deal with it—out of a body of officials, deputies, who had been using this lamp for years, finding a cap upon a lamp was a very difficult question. We measured and we tested and some of them could see a cap with pure air, and others with 4 and 5 per cent. of gas with colza petroleum, could not see the cap.

15982. (*Chairman.*) You think that men ought to be trained to see caps, and to know what caps are like ?—Certainly, they should be trained with the explosive and they should be trained with the electric arrangement. I may say, speaking of the training, that with a body of men I trained, although they were old officials when I took charge of the colliery, there was a general weeding out altogether. They could not take on the permitted explosive system.

15983. They had an objection to it ?—No, there was no objection. They were old officials but they could not grasp the training.

15984. They did not know how to use the permitted explosives ?—They could not learn how to use them. They were so saturated with the old powder and fuse that, adopting another phrase, "they would not go to school again."

15985. What happened, because they had to obey the Explosives Order ?—They had to go to other work and I had to train other men.

15986-8. You succeeded in training men ?—I succeeded in training men ultimately, but I had to draw my supply from men other than what I found upon the official staff.

15989. Do you wish to say anything about the analyses that you have made ?—I wish to hand in the following report on an analysis of samples of dust from the Linby Colliery :—

PUBLIC ANALYST'S LABORATORY,
SHEFFIELD,
March 18th, 1907.

REPORT ON FIVE SAMPLES OF DUST RECEIVED FROM THE LINBY COLLIERY ON FEBRUARY 23RD, 1907.

The samples gave the following results on analysis :—

	Moisture per cent.	Carbon per cent.	Volatile Matter, per cent.	Mineral Matter (Ash), per cent.
Dust from timbers at Pit bottom	5·11	53·95	23·46	33·11
Dust from floor at 500 yds. from Pit bottom Haulage Road..	4·05	20·68	18·44	68·69
Dust from timbered side 500 yds. from Pit bottom, Haulage Road	3·00	14·99	12·55	76·88
Dust from No. 57 Main Road from side and top Horse Road	3·75	25·67	16·28	62·31
Dust from No. 48 Road from side and top, Horse Road ..	2·74	19·13	13·73	70·31

REPORT ON THREE SAMPLES OF COAL (FRESHLY HEWN).

The samples gave the following results on analysis :—

	Moisture
Hard Coal, or dull shaly looking Coal ..	7·52 per cent.
"Rifler," or sample containing crystals	9·54 ,,
Soft Coal, or ordinary lustrous Coal ..	7·73 ,,

(*Signed*) A. H. ALLEN AND PARTNERS.
G. E. SCOTT-SMITH.

Mr. Henshaw has been before you, and has no doubt given you a copy of his paper upon the Courrières explosion which he read before the Federated Institute. You will find in that paper that 32·40 per cent. of ash cut off the explosion and saved No. 5 pit, and 42·30 per cent. arrested an explosion. Mr. Henshaw's own statement to me was that it was clear as if cut by a knife. In the pit bottom with us I have 33·11 per cent. of ash. The highest they had at Courrières was 64·95 per cent. Mr. Hall, in the experiments which he made, could not explode the Radstock series of dust, and that gave 46·8 per cent. of ash. Then our moisture in the coal, it is all one piece of coal, but as I said before part of it is soft and part hard, is 7·52, 9·54 and 7·73 per cent. There is no danger that I can see from an explosion upon our coal if we use those explosives.

15990. (*Sir Lindsay Wood.*) Are your mines considered to be dry and dusty ?—They are dry, but where is the standard to measure them as dusty ? By what standard am I to measure them as dusty ? We do not say that they are dusty, but probably an Inspector of Mines passing down would say they are. There is no standard.

Digitized by Google

15991. There is no standard as to the amount of dust, but still there is a question as to whether there is much dust in a mine at all. ?—As far as the main roads are concerned upon which the men travel, I should say that they are as hard as this table, but there is dust upon the timber. We water, but we let the water flood upon the floor and fill out the dirt. As far as watering is concerned, we flood from 11,000 to 13,000 gallons a week upon the haulage roads. We do not flood the return airways and fill out. We contend that we are not dusty, and when the mine is working with haulage engines the men have a system of signalling to one another when they want assistance by waving a safety lamp. It is a straight road, and you will see the light past 3 and 4 junctions, that is 660 to 880 yards. There is no dust in the atmosphere to prevent that.

15992. I rather had the impression that your mines could hardly be called dry and dusty mines; I do not mean to say that there is no dust in them, but what would be termed dusty under Rule 12 (*h*)?—Our inspectors do say that we are dusty, but we do not say so, and we claim that we are not dusty by the methods that we take in watering and filling out the dirt before it comes to dust.

15993. You do water the bottom?—We water at the bottom 11,000 to 13,000 gallons a week.

15994. Over what length of road?—My haulage roads are 5¾ miles and 10 miles worked by horses.

15995. That is 15 miles?—Yes.

15996. That is the length upon which you distribute this water?—Yes, we give more attention to the haulage roads and the main horse haulage, which I suggest should be included in the Explosives Order. There is a danger by flooding the rails of trams with lockers slipping, and in those places we cannot always do it. We try to do it at the week-end.

15997. Have you had any explosion in your mine at all?—No.

15998. Have there been many in your district?—Leen Valley, five collieries, no; but in the Midland Inspection District, in which I have had previous experience, there have been.

15999. (*Mr. Smillie.*) In reply to a question by the Chairman as to blown-out shots, you referred to the Wingate explosion?—Yes.

16000. Was that explosion caused by a blown-out shot?—I should not call it a shot at all. There was an unstemmed shot. That corroborates my claim that men should be examined. There you have an experienced stone-man who deliberately places an explosive, although a permitted one, upon a piece of stone, unstemmed, and fires it.

16001. He was supposed to be a thoroughly qualified man?—Yes, and there would be his certificate given by the manager, who is taken to be the person to grant that certificate.

16002. Would a shot of that kind have the same effect in causing an explosion as a blown-out shot, a shot of the kind supposed to have caused the Wingate Explosion?—That explosive is a permitted explosive. I have always supposed that the Woolwich tests were such that if a shot did blow out it would not fire the gas, although in the Explosives Order that was issued on the 20th December, 1897, I believe that was the second Order that was issued, Sir K. Digby issued a caution which has never been repeated in any other Order. The people who had come under the Explosives Order since, some years after, probably did not preserve their Orders. They have missed that caution. There he calls attention to the fact that, although it is a permitted explosive, it may not be fired anywhere. In other words, you cannot take a permitted explosive and fire it in a gasometer.

16003. My point was not the nature of the explosive itself, but the method by which it was fired. Would a shot by a permitted explosive, in which no hole was drilled, merely placed on top of the stone, be as dangerous in a dry and dusty mine as a blown-out shot from a properly drilled shot-hole?—If I had a workman in a mine who put a permitted explosive on top of a stone and fired it I should try all in my power to send him to prison for six months, because that is a breach of the Regulations.

16004. I think in all probability that is the course you would take, but I should like you to answer that question. I was asking whether or not the effect of a shot by a permitted explosive placed on top of a stone in exploding would be the same in a dry and dusty mine as a blown-out shot?—More dangerous, a shot from the top of a stone than a blown-out shot. I am assuming, and have always assumed, that a permitted explosive blown out will not fire the gas.

16005-6. This was not a blown-out shot?—No, it was not stemmed.

16007. We are all agreed that Wingate was fired under conditions under which it ought not to have been at all?—Please do not penalise us for that.

16008-9. Shot firing under such conditions as Wingate was fired, while it is against the Explosives Order and everything else, would not send out vortex rings?—I am not prepared to say; I want tests for that. I think it would in the position in which it was placed.

16010. Would a shot merely placed on the top of a stone with a small hole cut in the stone be likely to send out vortex rings?—I think so from the position it was surrounded. Then you must take into account also the question of explosives, although it does not apply to Wingate, the diameter of the hole with regard to the charge and the effect upon the stemming of a charge from a large hole and a small hole. That is a subject that should also be included in experiments.

16011. What is the nature of the roof of your mine. Are mines in the Leen Valley generally of a soft nature?—Very soft. We should work in the stall under a coal roof. Above that is soft bind.

16012. Do you leave a portion of your coal on as your roof under ordinary conditions?—Not in the gateway; we cut it down.

16013. Above that the material is of such a nature that if you wet it it would be likely to give way and come down?—I wetted three lengths of road, two once, and before they had quite finished wetting it I ordered the road to be fenced off because it was dangerous to pass under.

16014. Your bottom is of a different nature, your pavement or bottom floor?—It lifts with the watering that we do now.

16015. To what extent does it lift?—Considerably.

16016. Is your system of working longwall?—Yes.

16017. Your coal is handpicked usually?—Yes.

16018. Do you put away your small coal in the gob?—Yes.

16019. So that you are not as likely to have a large amount of coal dust on the roadways as you would if you filled all your small coal?—Not coal dust.

16020. You are not as likely to have as much coal dust on your roadways and your haulage roads?—No, the speed of the haulage will influence that very much.

16021. The method of filling the coals will influence that very much?—Yes, it is all hand-picked.

16022. The Commission understand by slack small coal. I think that you have a local name for a certain portion of your coal seam—it is called slack?—The bottom coal is an inferior coal and is sent out by itself. The slack that we have commercially is slack made upon the belt in dressing the hard and soft on the belt. It is paid for at coal price and it is really the dressing.

16024. Would your mines be considerably more dusty than they are now if you filled the whole of your coal. Is it not likely that your haulage roads and roofs and sides contain a larger quantity of fine dust than if all your coal was filled at the face?—I think that you are labouring under a mistake. The slack made in getting the coal is a small proportion and is so mixed up with the dirt from above the coal and the floor that I do not see how it is possible to do it.

16025. You do make some small coal, because you told me that you put it into the gob?—We throw it into the gob, but you could not keep that small coal clean. There would be more dirt than coal. There would be 60 per cent. of dirt if you used the shovel.

16026. From the fact that on your wagons the coal is in such nice round pieces, very little of it will fall off in transit to the pit bottom?—The tubs get broken and the men are called to order about it.

16027. Your tubs are open ended?—Yes. Why I brought that photograph is because I believe you have had from our district a gentleman who said that he made his dusty pit into a clean pit by making his tubs fast ended. I have brought that photograph to show the size of the coal, and where you have only three inches in height above the top of the tram, it is impossible with a fast-ended box to fill that coal. The gentleman handed in a paper which he read before the Institute, but I should be

Digitized by Google

Mr. H. Stevenson.

20 Mar. 1907.

surprised if he handed in the discussion that followed after.

16028. Have you had any personal experience of the quantity of coal dust necessary to continue an explosion when once it is initiated ?—In the air or on the sides ?

16029. On the sides ?—Myself, no. I am only talking from the reports that have been issued. I quote Mr. Henshaw, and, unfortunately, in the Wingate Report no analyses are given of the dust upon the roads where the explosion has not passed over.

16030. The quantity might depend upon the nature of the dust ?—I beg your pardon, the nature of the dirt and the ash upon roads where the explosion has not passed over is not given. Taking a sample of dust on a road where the explosion has passed over it is probable that a current of dust is brought from some other district, and it is not in the same state as it was before the explosion.

16031. There is some dust on your main haulage roads ? —You have a sample that I have handed in.

16032. Have you formed an opinion as to whether or not there is sufficient dust in your main haulage roads to carry on an explosion when once initiated ?—Comparing the analysis of dust at Courrières and Mr. Hall's at Radstock, my dust is of such a nature that it could not continue an explosion. The ash is in excess of Courrières ; it is in excess of Radstock where he could not get an explosion.

16033. Have you much gas in your mine ?—No.

16034. Do you meet with much in the workings ?—In bodies, no ; in small quantities I use this lamp and I do find it ; all gas is reported if it is not as much as would fill a tobacco box. If it is there it is reported. Probably we shall get one or two cases a week. Our ventilation is very strong, and by our system of inspection we do not wait for an accumulation to take place ; a man must guard against it. If a man finds it clear he must keep it clear.

16035. Have you found at any time during your experience an ordinary safety lamp showing a cap in the return airway ?—With what illuminant ?

16036. With the ordinary illuminant used in the mine ? —No. I have with the alcohol lamp.

16037. That is very sensitive ?—You have it there. It was a question of discussion between the inspector and myself. I admitted that there was a cap, but it was so small that I could not give it a height and we agreed to differ.

16038. That was a cap with alcohol ?—Yes.

16039. You could not have found that with colza ?—No.

16040. Do you consider that it would be safe to allow the men to remain working in the mine where you could find a cap of a ¼-in. with colza in the return airway ?—I do not think that you could define ¼-in. ; it would require a very practical man to define ¼ in.

16041. Could you define what length of cap shown on a safety lamp with colza would be dangerous ?—Yes.

16042. What length of cap ?—Your getting about 3 or 4 per cent.—not as dangerous. I should withdraw the men as a precaution ; it would not be dangerous. It would not fire in the lamp; it would not cause an explosion.

16043. But it might be dangerous if an explosion took place at the working face or it might be dangerous to carry on an explosion ?—You must have another adjunct.

16044. The presence of coal dust ?—No, the coal dust that we have in our face would not influence that cap or that explosion.

16045. Do you think that anything could be done to render the mines of this country more safe than they are at the present time from extensive explosions ?—Powder is one of the best coal getters, there is nothing to equal it at the present time, and he would be a very brave man who suggested that all powder should be excluded from a mine ; and in fact there is something else to discuss, there are the men to discuss with it. Under certain circumstances powder might be allowed at the coal face fired by an official in all cases, as I have suggested, who should be competent, but I do not think that it would be a hardship in any way to prohibit powder being used in any of the gateways or the rippings.

16046. Powder is not permitted under certain circumstances now in dry and dusty mines ?—It is always with good roof that falls occur and always safe mines that explode.

16047. It is not the safe mines or the mines worked with naked lights in which extensive explosions have taken place. Is it not in close light collieries ?—I have Timsbury in my mind and Camerton where they have been firing say 50 years or 100 years. In fact, I believe at Camerton they had not a safety lamp upon the place and there they had an explosion. Timsbury followed shortly after.

16048. We admit that there are more explosions in naked light collieries than there are in the others but many are not extensive. I think that is proved from the evidence What I rather wanted to get at was could you give the Commission any information as to any improvements, legislative improvements, which might take place to prevent the extension of explosions in dry and dusty mines when they have been initiated ?—To prevent the extension—prevent the cause ?

16049. If there were no cause there would be no extension of course ?—There has been no explosion upon a main road, that is a main haulage road, with a permitted explosive that is upon our present list. To prevent the cause reduce the use of powder, restrict it, place it in certain hands, and I do not think that there will be much danger.

16050. An explosion can arise from other sources besides shot-firing on main roads ?—It may arise from an explosion of gas.

16051. It may extend to the whole of the intake airways and very extensive workings ?—At Tredegar the explosion went down the return. At Blackwell the explorers went in by the return, but you cannot fix a hard and fast rule.

16052. Can you suggest any method by which an explosion, having originated either at the coal face or by a shot fired in the main haulage road or air course, could be prevented from extending to other parts of the workings, Have you any suggestion to make ?—I take it with the shot on the main haulage road that you are carrying out the Explosives Order and the Coal Mines Regulation Act, that floor, roof and sides are wet, and that a permitted explosive is used.

16053. Yes.—I do not see that you would have an explosion or there is very little good in the permitted explosive.

16053A. (*Mr. Ratcliffe Ellis.*) I suppose that you recognise the danger of dust in connection with an explosion ? —Yes.

16054. You have had experience beyond your own district and beyond your own colliery ?—Yes.

16055. Have you formed an opinion as to whether there can be an explosion purely of dust, or must there be some amount of gas ?—I do not admit that dust, coal dust I take it that you refer to can explode. There is an experiment used upon the lecture table whereby from compression of air a substance can be fired, but you do not get that condition in a mine. With the Chairman's permission I should like to read a definition that was arrived at by the Chesterfield and Derbyshire Institute of Engineers, I think about 1880, when they carried out some dust-explosion experiments. They came to the conclusion that a definition of explosion is "anything which causes a sudden increase of pressure in the surrounding air or gases from the sudden and violent expansion of any substance (gas, liquid or solid) in the neighbourhood." Coal dust will not do that, but it may cause an inflammation, and they consider that " the ignited coal dust will travel along with the flame at the same velocity without increasing the velocity."

16056. Your view is that to originate an explosion there must be some quantity of gas, that dust itself will not do it, but the presence of coal dust will continue an explosion and make it more disastrous than it would have been if there had been no accumulation of dust ?—For that I must rely upon experiments by private people, not by Government. Whether their apparatus are crude or whether they worked upon right lines and a right basis I cannot say. Their statement is that a small quantity of gas will with dust continue an explosion. I do not accept it.

16057. You have an opinion yourself about it. In your own mine although you have dust you have no shot-firing at all ?—No, very slight shot-firing in the district.

16058. I am speaking first of your own mines : you have no shot-firing at all ?—There has not been a shot fired I am given to understand in the coal or the ripping since the pit was sunk.

16059. Do you work with lamps ?—As a precaution, not as a necessity.

16060. Throughout the pit you have only lamps, you have no naked lights ?—The pit bottom and the incline heads which are close to the pit bottom.

Digitized by Google

16061. In other mines in your district which you represent the shot-firing does take place ?—Yes.

16062. Both at the face and in the roadway ?—Not at the face ; individual cases where the ground changes, and probably a bit of hard stuff. Ten shots a month will be the outside.

16063. They fire in the roadways there ?—Yes, under the Explosives Order, permitted explosives.

16064. The shot-firer, the person who fires these shots, is a specially-appointed person for the work ?—Yes.

16065. Do you suggest that there should be some examination necessary ?—I do.

16066. Before he should be competent to be appointed ? —I do.

16067. Who would you suggest should make that examination ?—A similar board to the——

16068. That he should have to have a certificate ?—He should have a certificate for that occupation of a lesser degree than the present under-manager, but the examination should be adapted to his requirements.

16069. At the present time the shot-firer is appointed in writing, is he not ?—Yes.

16070. Do you know whether any special instructions are given to him or special rules handed to him, or is he specially instructed as to his duty now ?—Every workman must take a copy of the rules upon entering the employment ; in some cases the rules and regulations are printed upon the certificate, and in others they are not.

16071. You do know of cases where there are particular rules printed on the back of his authorisation ? —Yes.

16072. Do not you think that a desirable thing ?—It is a desirable thing, but, unfortunately, as in my own case, you are placing an entirely new article in the old men's hands without giving them instructions. The County Council are paying a lot of money for mining classes and instruction, some portion of which they might devote to special classes for instructing the deputies and others in shot-firing. I found great difficulty in teaching my set of men. Unfortunately, the Blackwell explosion had occurred a few weeks before I took charge of that group of collieries. Mr. Stokes, the Inspector, did not admit that dust in our district would cause an explosion.

16073. You appreciate the necessity of persons firing these shots being properly instructed as to their duties ?— Certainly.

16074. At any of the collieries you are connected with or represent is any precaution taken to prevent dust going down the shaft ?—No, they are all open.

16075. Do you think it necessary to do anything to prevent that ?—As far as we are concerned, no.

16076. Are some of the collieries in the Midlands much more dusty than your present collieries ?—Yes, but the amount of dust in those pits would not have any effect in going down.

16077. You do not think the quantity that would go down—— ?—There is no quantity of it, and it depends upon the direction of the wind. You must keep it in a certain direction to carry it on to the pit.

16078. If there is a draught in the downcast shaft it would soon suck a good deal of the dust down, but you do not think that sufficient could go down to make any appreciable difference down below ?—I instance when the arching in my pit bottom was whitewashed. You will find that I refer to it. It was whitewashed in 1905, and we have not whitewashed it since.

16079. Not much dust goes down there. Do you know of any collieries where they take any steps to remove the dust down below, put it in a box and take it out to the top ?—From the floor or from the sides ?

16080. Both from floor, sides and roofs ?—From the floor, we do all down the Valley ; roof and sides, no.

16081. Is that the only case ?—Yes. The amount of dust there is no comparison ; there is not a mine in England similar to it.

16082. You remove your dust from the floor ?—I remove the dirt from the floor before it becomes dust.

16083. Where you have horses the trampling of the horses would probably render the coal dust harmless, the dust which would mix with it ?—You have analyses of dust from where the horses are. You will notice that the dust upon the haulage road 500 yards from the pit bottom is very little different.

16084. Where would you expect to find the most dangerous dust in the mine ?—In my own mine ?

16085. In any mines which you are acquainted with which are dusty ?—You would get the most dust upon the mechanical haulage roads.

16086. Dust in order to either originate or assist an explosion must be in suspension, suspended in the air. As long as it sticks to the timber it would do no harm ?— I do not say so. I am assuming, as at Timsbury and Camerton where something in one shot causes the explosion, that a vortex ring was running in front of the flame and brushes the dust from the timbers. As far as suspension goes you can take a white handkerchief from one end to the other end of our mine without getting it dirty.

16087. The dust must be in the air ; it must be in suspension ?—At the same time that the flame touches it.

16088. Do you think it possible for the flame to travel faster than the blast and for the flame to pass any particular point before the blast following it brings the dust into suspension ?—I do not think that the flame would go in front of the blast.

16089. Would they go together ?—The blast would be first.

16090. They go together ?—Practically together.

16091. You do not agree with the view that the flame might pass the point of danger where the dust was accumulated before the blast brought the dust at that point in suspension. You do not agree with that ?—No.

16092. With reference to watering, you would not agree with any universal compulsory system of watering ?— Certainly not.

16093. Even with exceptions, you would not agree to have the German system introduced which obliges everybody to water subject to certain exemptions ?—Your exemptions would outnumber your watering.

16094. Have you seen anything of the German mines ? —Yes, I have been down one, and I have also been on the banks of several of them, and by the colour of the men when they come out they need to be washed before they go home. I referred shortly to the Courrieres system in answer to the Chairman about the dust. The Germans have a system of forcing water into the solid coal to damp the dust before it is got down. A paper was written by Herr Meissner in 1906, and I have a translation of it here. In one of his paragraphs he says :—" Whereas previously during the getting of the coal, thick clouds of dust were set free, after the saturation of the coal there was no dust whatever. The whole fall was damp. The air in the working place remained clear throughout the shift. The spluttering of the lamps which used to be had from the burning of the fine coal dust was scarcely noticeable." We have not that state of affairs in any mine that I know of. We have not a state of affairs like that, that the dust, when you get down the coal, will make the lamp splutter.

16095. You do not approve of the German system of watering. Do you think that watering of zones would be useful—certain areas in a mine ?—If you prevent an explosion you will not want a zone. It is like locking the stable door after the horse has gone.

16096. Supposing you had an explosion, these zones would prevent it extending ?—To water a zone I should have the same difficulty as I have in a piece of road ; it would come in.

16097. To water a zone to make it effective you would have to do some brickwork to make a tunnel to prepare the road for the watering. Would you be able to keep that up for any length of time ?—It looks as if you would have to make a railway tunnel from the pit bottom to the working.

16098. To the zone ?—Right away through.

16099. I was suggesting a zone instead of watering to be protected by watering or by cleaning from the dust altogether. You think it doubtful whether you could keep masonry up ?—You could not keep masonry up.

16100. You could not water in that way ?—Will you excuse me a moment ; will you refer to that tracing I gave you and will you suggest anywhere where a zone should be placed to protect that area ? It is all moving ground. (*Indicating on tracing.*)

16101. I daresay in your own colliery, but I want to go over a little wider area ?—Very well, you shall take the whole district and the same will apply to each colliery.

Digitized by Google

Mr. H. Stevenson.

20 Mar. 1907.

16102. In the Leen Valley there could be no arching or making preparation of that sort so as to make watering effective?—Not in the least.

16103. In the same way it would apply to making it effective for clearing away the dust?—The same would apply to the plaster. As I pointed out the plaster would prevent your examining the roof and sides in the moving ground which you have down there.

16104. You do not see any way in which you could deal with this dust at all?—Excepting watering on the floor as we are doing and filling the dirt out.

16105. I do not understand why you water on the floor?—That is where the dust is first made by friction of the road and the crushing of the coal that falls out of the tubs and the tramping of the men and horses.

16106. You work with lamps and you have no explosive used down the pits. What is the object of this watering?—Precaution.

16107. Against what?—To make it more comfortable.

16108. For a sanitary reason?—Yes.

16109. To make it more comfortable for the men?—And then there is probably a little selfishness in it. There is a certain amount of water made in the shaft which is no good for the boilers, but we have the water to get rid of and we make a virtue of a necessity.

16110. With regard to the regulations as to shot-firing under the Coal Mines Regulation Act and under the Explosives Order, have you any additional precautions to suggest beyond what is now provided for?—Yes. We have gone over the ground that a shot-firer should have a certificate; that the shot on the main road, that is, the haulage road, should have permission, and I also include main horse roads under that heading. You have the dust there, more dust than what you have upon your haulage roads, I think. If you will refer to the tracing I put in, I show a limit of 100 yards from the coal face, so that the 100 yards would be in practically new ground. It would be about nine months old as far as my workings are concerned; probably I am going faster than other people. I am travelling 170 yards a year.

16111. Do you think it desirable that all shots in the main haulage roads should be fired during the shifts when the men are out of the mine?—That would not be a hardship. I say that would not be a hardship, probably it might be in some mines, for instance, my mine is never clear. We have men going in at 6 o'clock, we have men going in at 4 o'clock, and we have men going in at 9 o'clock, but I do not anticipate any danger from a permitted explosive in the Coal Mines Order.

16112. You think if that is carried out it is perfectly safe?—Perfectly safe.

TWENTY-FIFTH DAY.

Thursday, 21*st March*. 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

H. H. S. CUNYNGHAME, Esq., C.B.
THOMAS RATCLIFFE ELLIS, Esq.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. GEORGE HENRY PEACE, called and examined.

STATEMENT OF WITNESS.

Mr. G. H. Peace.

21 Mar. 1907.

16112a. I have been requested by the Lancashire and Cheshire Coal Association to give evidence on the question of coal dust and watering of mines.

(1) I am of opinion that the solution of the difficulty is very largely to be found in the suggestion of the first question *i.e.*, by preventing the accumulation of inflammable dust. I think this course is far preferable to attempting to deal with the dust after it has accumulated. Much might be done in rendering the wagons dust tight. At our more modern collieries for some years we have been using wagons made entirely of iron, and we find that this practically prevents any coal dust on the roads. In the case of wagons made of wood a great deal may be accomplished by having the boards tongued and grooved and properly jointed at the corners and bottom.

(2) I have no experience of covering wagons or spraying journeys, and as most of our haulage is of a slow speed, about 2 miles per hour, we do not find in practice that the dust is lifted off the top of the wagons to any appreciable extent.

(3) There would be considerable difficulty in many cases in removing the screens at established collieries away from the shaft, but I am of opinion that at new collieries it is desirable to fix the screens at a distance from the downcast shaft, though I do not agree with the distance named by one of the inspectors (Mr. W. Walker) of 100 yards. Much depends upon the relative position of the screening plant and the shaft, and what protection is afforded by the buildings, walls, &c. In a recently established colliery we fixed the screens 60 yards away and this is quite effective.

(4) There is considerable difficulty in collecting the whole of the dust from the screens, but where it is not practicable to remove them away from the downcast shaft, no doubt it could be mitigated considerably by suitable appliances.

(5) I am strongly of the opinion that in the case of our mines any complete watering of the roadways would have disastrous effects. With the exception of some small portion where the roof is rock, our mines have a fireclay floor and shale roof, and if either of these is watered effectively, the result on the floor would be to cause it to lift very rapidly, and so disturb the sides of the roadway, and if the roof and sides are watered, the consequence would be still more serious, as they immediately begin to crumble and the risk of accident would, in my view, be greatly increased.

(6) The fatalities due to accidents from falls of roof and sides are now considerable, and in my view these would be increased if the sides and roof were repeatedly saturated with water, as the falling of small pieces would tend to render the timbers insecure, and also would be liable to fall or roll on to the rails, and so throw off the wagons as they were passing along. Especially would this tend to accident where the roadways are on an incline, as in our case, of about 1 in 6. Moreover, I think the continual wetting of the timber would render it more liable to fall, and also reduce the life. Again, in the deep mines which are now being more extensively worked, the air is so dry that it quickly absorbs any moisture which may be present from watering, so that

Digitized by Google

to be effective it would have to be repeated at short intervals.

(7) As regards the system of watering in Germany referred to in the report of Dr. Haldane*, I do not consider this system suitable for such mines as ours, unless a very liberal interpretation of the exemption (Paragraph 34 [3]) were allowed.

(8) I consider the alternatives suggested by Dr. Haldane, Mr. Hall and Mr. Atkinson, would be much preferable, with the exception of the last in No. 3 as to the provision of wet and dustless places at least 100 yards in length. There would be some practical difficulties in carrying out this suggestion, as in some cases the end of the haulage road is being continually extended, and it is not possible to arch or otherwise permanently secure the roof within 100 yards of the working face. If it is sufficient to wet only the floor and keep the roof and sides free from dust by brushing at intervals, I think this could be carried out.

(9) If the same object can be attained by keeping the roads free from coal dust without watering them, this would, in my opinion, be much less expensive, and also tend to greater safety.

(10) The difficulty in arching these zones is that whether brickwork or timber is used the life is a comparatively short one, and the expense and risk of accident in enlarging those archways is much greater than in ordinary timbering.

(11) I have no information as to the cost of watering a mine completely, but the system we have in operation for partially watering is an iron tank with a small semi-rotary pump fixed upon it with a flexible hose pipe. With this apparatus one man can water a considerable extent of the road at a comparatively small cost.

(12) I have already indicated some defects which would arise from watering in our mines, and in addition would point out that as the mines are now from 700 to 900 yards in depth, if watering was possible it would have a serious effect on the working capacity and the health of the workmen themselves, as instead of the air being dry, as at present, it would be more or less moist.

(13) We have recently tested the temperature at some of our lowest workings, and we find that in the strata it is over 90 degs., and in one case, in passing through the working place the temperature was increased from 60 degs. in the intake to 84 degs. in the return.

(14) I consider it would be better to keep the roadways free from dust by sweeping or otherwise, than to attempt to water such mines as would be affected by watering the roof, sides and floor.

(15) I have no experience as to the use of salt or other hygroscopic substance, but I think the suggestion made by Mr. Hall in his evidence is well worth further experiment.

(16) As regards the mixture of non-inflammable dust with coal dust, this already does occur in the dust found both on the floor, sides and timbers; and I think the reports of the Courrières explosion indicate that where there was a major proportion of non-inflammable dust lying on the floor the explosion there ceased.

(17) I think it is very desirable that experiments, should be made with the various kinds of dust to ascertain whether they are inflammable or not, and following this to qualify the term "dry and dusty" mines.

(18) In regard to shot-firing in main haulage roads where only one shift of coal-getting is in operation, I think it might be possible to prohibit firing during shifts; but where two shifts are worked it is not practicable. In the latter case some alternative might be suggested, such as the use of the old water cartridge which was invented by the late Mr. Miles Settle many years ago, and the use of which we have revived as an additional precaution. We find that it both prevents any flame and absorbs the fumes from the explosive. and also seems to rather increase the spreading of the shot.

16113. (*Chairman.*) You are a member of the Institution of Civil Engineers, a member of the Manchester Geological Society, and also of the Institute of Federated Mining Engineers?—Yes.

16114. You are Past-President of the Lancashire and Cheshire Coal Association, a member of the Executive Council of the Mining Association of Great Britain, and Managing Director of the Astley and Tyldesley Collieries, Limited?—Yes.

Mr. G. H. Peace.

21 Mar. 1907.

16115. Has your experience been entirely in Lancashire and Cheshire?—Almost entirely.

16116. Have you had any other experience?—Beyond being consulted in various matters, I have not had any intimate acquaintance with other mines.

16117. You have been consulted about mines, but you have not gone down mines in other parts of the country?—Only to see special matters, not to go thoroughly through the mines. I have visited a good many mines, both at home and abroad, but more for the purpose of investigation of special objects than in relation to this matter.

16118. As regards the question of coal dust, you would prefer to speak entirely of your experience in Lancashire and Cheshire?—Yes.

16119. You say that you think it is better to prevent the accumulation of inflammable dust than to attempt to deal with it after it has been accumulating?—Yes.

16120. As regards wagons, you say that for some years you have been using wagons made entirely of iron, which practically prevent any coal dust on the roads?—Yes.

16121. We have had a good deal of difference of opinion with regard to that; some witnesses think that if wood wagons are properly made, as you say, by having the boards tongued and grooved and properly joined, they are just as good as iron wagons?—Provided the joints are properly made, that is so.

16122. Then you would not say that there is any very great difference in the matter of prevention of dust between a well-made wooden wagon and an iron wagon?—Provided it is made so that the dust cannot trickle through the joints.

16123. Yes, but can you assure a wooden wagon being made and continuing to be dust-tight for any considerable period after it has been in use?—The difficulty seems to me to be in jointing the side and end boards to the bottom boards. There is a little practical difficulty in making that absolutely secure, but I do not think it is an insuperable difficulty.

16124. When it is made secure to begin with, will it last?—If the timber is properly seasoned before it is made, and regard had to the inevitable shrinking which there will be, I think it might be got over.

16125. Then how would you deal with the inevitable shrinking?—So far as the side boards are concerned, tongueing and grooving those would be sufficient. To make a proper joint at the bottom and ends it seems to me there would have to be a similar arrangement there—the boards would have to be grooved after the bottom is made, and the tongue put in between the side board and the bottom, so as to make a perfectly tight joint there.

16126. That is not done at present?—That is not done at present.

16127. So that in your opinion the wooden wagons at present in use might be improved upon?—I think so.

16128. It has been suggested that where the inclines are very steep the weight of an iron wagon might cause danger and be more likely to break away and to run over people?—Our experience is that, taking the capacity of the tub or wagon, there is not very much difference in the weight.

16129. Not sufficient difference to be of importance in the matter of danger?—No.

16130. Then you say you do not spray because your haulage is at slow speed?—Speaking generally, we have only one incline that is at a moderate speed; all the others are slow.

16131. Then you do not spray even where you have what you call the moderate speed. At what rate per hour would the moderate speed be?—I should think probably 6 to 8 miles an hour.

16132. In case of haulage at the rate of 6 miles, you do not think it necessary to spray?—I do not think so.

16133. But I suppose if there is any jar, by reason of the roughness of the road, from one wagon bumping against another, there would be considerable dust, would there not?—We do not find much of that, because in our haulage roads we use entirely fish-plated rails, and almost entirely

* Minutes of Evidence, Vol. I., Appendix XV.

Digitized by Google

Mr. G. H. Peace.

21 Mar. 1907.

steel sleepers, so that we get a perfect running road, almost like the main line of a railway.

16134. But I suppose every now and then when wagons come to a stop, or for any reason bump up against one another, there must be coal dust coming out ?—We do not find that there is any damage ; we have never noticed any. Speaking generally, the journey runs right from the bottom of the brow to the top without any stoppage.

16135. So that in the case of your mines there is very little dust deposited from the wagons ?—That is so.

16136. Then a certain amount of dust, no doubt, comes down from the screens ?—That is so, if the screens are near the downcast shaft.

16137. But there are means of preventing that, are there not ? You could have fans to carry the dust in a particular direction—to collect it ?—That is one mode, and I think a good deal can be done by protecting the shaft by walls or screens, and arranging it so that the screening sheds do not allow the dust to get in the direction of the shaft.

16138. But where it is reasonably possible, you think the screens ought to be placed some way from the downcast shafts ?—In new collieries, certainly. We have adopted that method ourselves in our modern collieries.

16139. Do you think that a General Rule to that effect might be made, that in all new collieries, at all events, where it was reasonably possible, the screens should be a certain distance, say 60 yards, from the downcast shaft ?—I think so. I should not like to bind myself to 60 yards, because we have another case in which the distance is much less, but, owing to the formation of the walls surrounding the pit bank and the position of the screens, we find that as a matter of fact the dust does not go down the shaft, although the distance is much less than 60 yards. Of course I agree that if the shaft was open and you had nothing to prevent the dust getting in that direction, there might be difficulty. But I think 60 yards is rather more than need be fixed as an absolute limit, if regard be had to preventing the dust getting to the shaft.

16140. Then you suggest that if a colliery owner or manager wanted to have the screens in a new colliery less than 60 yards from the downcast shaft, he should be obliged to show some special reason why the Rules should be relaxed ?—Well, I should not like to bind myself to 60 yards. I mention that as being one case in which we did arrange it 60 yards away.

16141. I suppose something like 60 yards would be reasonable ?—Yes ; 50 yards would be reasonable, I think.

16142. In the case of mines where the screens are now near the downcast shaft and cannot very well be removed, perhaps you would think that there should be some compulsion, or would you say that there should be some compulsion applied to mine managers to provide some suitable appliances to prevent the dust giong down the downcast shaft, such as I have suggested—fans, or some means like that of dealing with the dust ?—In view of the danger there seems to be from coal dust, I think it is desirable.

16143. Have you gone into the question of the greater explosiveness of screen dust to any other dust ; because it was stated by some witnesses that they were quite satisfied that the dust which comes down into the mine from the screens is more explosive than any other kind of dust found inside the mine ?—I have no actual experience of the fact, but I have been told that that is so.

16144. The suggestion has been made that you might have a drift communicating with the downcast shaft, and that you might ventilate through the drift, and that the mouth of the drift might be some little distance from the screens, so that in cases where it was impossible to remove the screen, and where there was any great difficulty in having appliances, that would prevent the dust going down the downcast shaft, and that you might ventilate it by means of a drift ?—There would be some practical difficulties in that, because you would have to close the top of the shaft.

16145. But there would be very little down draught in the shaft, I imagine, if it was ventilated by a drift ?—I am afraid the air is like a good many people—it takes the shortest cut.

16146. You think that notwithstanding anything you could do by way of endeavouring to carry the current of air down into the mine, not directly by the downcast shaft, but by a drift leading into the downcast shaft—notwithstanding all your precautions, the probability is that there would be a considerable down-draught from the top of the downcast shaft ?—That is so, because it would be the shortest course.

16147. With regard to complete watering you say that if you had complete watering the floor would lift and disturb the sides of the roadways, and if the roofs and sides were watered, the consequences would be still more serious ?—Yes.

16148. I suppose you have watered from time to time, and you find from experience that that is what results from it ?—That is so.

16149. But you think it would be less disastrous to water the floor only than to water the roof and sides, and that the roof and sides are the great difficulty ?—Yes.

16150. Supposing you found that you could water the floor either, say, by making the floor of brick, or that you could water it without its heaving too much, I suppose that would have a considerable effect on the dust, would it not ?—Yes, it would.

16151. Even if the roof and sides were quite dry ?—I think the suggestion of Mr. Hall as regards the use of salt or something of that sort, on the roads would be effective in many cases quite as much as watering.

16152. That would depend a good deal upon the humidity of the atmosphere, would it not ? Some witnesses have told us that they found it no use to put down salt because the atmosphere was so dry that there was no moisture upon it, so that it had no effect upon the dust ?—That is so.

16153. So that it would be only in mines where there is a certain degree of humidity that it would be of any use to put down salt ?—Yes ; but I think it is well worth experimenting upon further, because in some mines the watering of the floors unless it is very carefully done, would inevitably result in the rising of the floor.

16154. Supposing you bricked the floor, would that do very much good, and would it enable you to water where you could not otherwise water without damage ?—If the brickwork was cemented so that the water could not get through I can quite imagine that it would not do much harm to the floor ; but if the bricks were left open I am afraid the water would go through, and you would get very much the same result.

16155. I suppose if there was a great deal of heaving of the floor the cement would break, and you would have the difficulty anyhow ?—That is the difficulty in any case.

16156. You agree with a great many other witnesses whom we have heard that accidents from falls of roof and sides would be increased by any considerable watering ?—I am afraid that would be so.

16157. Then you say that continual wetting of the timber would, in your opinion, render it more liable to fall and also reduce the life of the timber ?—Yes.

16158. What have you to say with regard to that—because we have been told that it would undoubtedly tend to make wood rot to keep it alternately wet and dry ; but there seems to be some difference of opinion as to whether it would injure the wood if it was constantly kept damp ?—I am afraid that in deep mines you could not possibly keep the timber damp continually. It is surprising how quickly the moisture dries up in deep mines.

16159. Have you gone into the system of watering in Germany ? Have you been down mines in Germany and seen how the watering is carried out there ?—No, I have not been down any of the German mines ; I have seen some of the systems of watering in South Wales, but that was many years ago.

16160. Do you think that if there was any system of watering made compulsory, as it is in Germany the exemptions would have to be so numerous that the rule would amount to very little ?—It would be so in Lancashire.

16161. Then you go on to deal with the question of the provision of wet and dustless zones at least 100 yards in length ?—Yes.

16162. You say it would not be possible to arch or otherwise permanently secure the roof within 100 yards of the working face. I do not know that it is suggested that we should adhere very closely to 100 yards from the working face ; I suppose if it was very difficult to make a dry and dustless zone, and if it was made at some distance, originally 100 yards from the face, probably that would be considered sufficient without carrying on the zone

Digitized by Google

to within 100 yards of the face during the whole course of working?—Yes; but I do not quite see the utility of a zone at the far end of the haulage roads, as is suggested. Take our course of working in one of our deep mines; we have no less than eight junctions on each of the haulage roads; so that supposing you put a zone near the far end—supposing for the sake of argument that it is not advancing and therefore it is permanently fixed—that would only protect a small area of the workings; you would have practically three-fourths of the workings which would not be benefited by that zone.

16163. But I think the idea is that wherever you have any cross roads or adits or any sort of passages crossing or going out of the main haulage roads there, you should have at each one of those crossings a dustless zone, if possible?—That I agree with; but my point is that, assuming those dustless zones are sufficient to stop an explosion, there would be no advantage in putting a wet zone just at the far end of the haulage brow.

16164. The idea is that if there is an explosion, say, of firedamp or anything of that sort, not necessarily an explosion originating with dust, but one which would be helped on by the dust, then you ought to have a zone not so very far from the face so as to stop the explosion as soon as you possibly could?—Yes, that is all right supposing that you have a haulage brow of 1,000 yards in length and the workings are all at the bottom end; but in our case, as I say, it would not protect more than about a fourth of the workings; the other workings would all be relying upon these dry zones at the junctions.

16165. Therefore you mean that in the majority of cases if there was an explosion these zones would not prevent the explosion travelling a very considerable distance—that some of the zones would have to be a considerable distance from the face where you are working supposing an explosion took place at the face?—Probably I might make my meaning more clear by a rough sketch which I have had made of one of our mines, if you care to see it.

16166. Yes, we will look at it (*the Witness produced sketch*).—That represents the coal ungotten, and these are two of the shafts.

(*The Witness explained the sketch to the Commissioners.*)

16167. What distinctions do you draw between the wet zones and the dustless zones?—I do not wish to draw any distinction; I consider that the dry zones are sufficient.

16168. You think that a dry zone stops an explosion as well as a wet zone does?—My point is rather this. If this recommendation had to be carried out, the 100 yards of wet zone would have to be in that part (*indicating on sketch*), and that would only protect *these* two places.

16169. Then you consider that a dustless zone would stop an explosion almost as well as a wet zone, and that wetting is only one means of preventing dust?—We have been doing a little in the direction of trying what could be done, and our experience is that by thoroughly sweeping the roof and sides and cleaning the floor, we can get the roadways practically free from dust.

16170. Do you clean the floor when the floor is dry, or would you wet it or damp it?—We only clean where the floor is dry.

16171. You do not think it necessary to damp the floor?—Not in the case I have mentioned, because, having the screens away from the shaft and having the iron boxes, we do not find any dust accumulating on the roadways; and what dust there is on the bars and timbers we find in most cases is not coal dust but shale dust.

16172. Then how do you get it down?—By sweeping it with a brush.

16173. Not by a jet of air?—No.

16174. You find sweeping it is fairly efficacious?—It is.

16175. I suppose you have had nothing to test your theory that this dry zone will stop an explosion; you have had no explosion, have you?—No, and I should not like to have one.

16176. When last did you have an explosion?—We have never had an explosion, I am glad to say. If I might say so, I think the Commission might ascertain more whether the different mines should not be differentiated. For instance, we find that in some of our mines, although probably they would come under the class of "dry and dusty," yet the coal is of such a nature that we do not find it flying about; and in my view the term "dry and dusty" is too wide to apply to every mine which is not absolutely wet or damp.

16177. Then you think that the mine ought not to be called "dry and dusty" unless the coal is of such a friable character that there is considerable dust flying about?—That is so.

16178. On the other hand, it has been said that a very small quantity of coaldust will carry an explosion quite as well as a larger quantity?—Yes, that has been stated and I think that is a direction in which there should be proper experiments made, because we are very much in the dark at present.

16179. However, you have had no experience of explosions; your experience happily does not enable you to speak with very much authority upon a point of that sort?—No.

16180. Would you suggest any test to be applied to a mine as to whether it was dry and dusty or not? For instance, if we applied certain Rules to dry and dusty mines and not to other mines?—I take it this question of dry and dusty is almost entirely confined to the haulage roads. Now, by a simple experiment you could ascertain whether the dust which is lying on the sides, on the timbers, or on the floor was of an explosive character or not, and that I think ought to be taken into account in defining what is necessary in the way of protection from the dust.

16181. You see the experiments might vary a good deal from time to time, because, supposing the method of haulage, for instance, was altered, you might find that at one time the dust was of a highly explosive character, and that at another time it was not so, simply because, by reason of a lot of dust from shale being kicked up by horse traction or in some other way, the coal dust had got mixed with non-inflammable matter?—That is so.

16182. I should have thought it would be a little difficult to differentiate between mines which ought to be considered dry and dusty and those which ought not. Then as regards arching and putting these zones in such a condition that you could deal with them by watering or by dusting, you say the expense and risk of accident in enlarging archways is much greater than in ordinary timbering?—Yes. We find that when we have put in lengths of arching, as we do not only of brickwork but occasionally of timber also—timber chocks, as we call them—speaking broadly, the life is only a year or two, and they have to be taken out and enlarged, and there is a great risk of accident in that case.

16183. Even in brick arches?—Either brick arches or timber arches.

16184. That is to say, that the bricks are squeezed together?—The bricks are squeezed together, and then you have to take them out, and it is difficult to get the new arching in without men getting caught. We find that in some of our mines where there is a modified system of timbering we have no difficulty whatever in cleaning the roof entirely.

16185. What do you mean by "a modified system of timbering"?—Well, the usual course is to put cross pieces of timber, and then longitudinal pieces on the top of these bars, as they are termed, and in that case there is a difficulty in getting on to the top. But in many of our mines we put up two shorter pieces at an angle and then longitudinal timbers, and then a short piece between—"cookers," as they are called; in that case you can get to clean practically the whole of the roof.

16186. That you find a better method of timbering with regard to keeping the mine clean?—Yes, and also better than arching as regards safety.

16187. How does your mine compare with other mines as regards falls of roof and sides? Is this method of timbering which you have just described carried out to any great extent—the arching method, as it were?—It is difficult to say because we have so many mines, and each mine has to be treated according to circumstances. I could not say off-hand what proportion we have, although we are certainly adopting it more largely than we have done in the past.

16188. Is it your opinion that where you do adopt this method, which I may call, perhaps, "timber arching," the accidents from falls of roof and sides are less frequent than where you adopt the old system; or have you not gone into that question?—We consider it is safer.

16189. But you have no statistics which you can bring forward to show that?—No, I could not give you actual figures.

16190. As regards the cost of watering mines, you say that by the use of an iron tank and a flexible hose-pipe one man's labour will water at a comparatively small cost?—Yes.

Digitized by Google

Mr. G. H. Peace.

21 Mar. 1907.

16191. Do you do that a good deal in your mine?—We only do it now for the purposes of shot-firing.

16192. When you fire shots do you think it is a compliance with the Rule only to water the floor, or do you consider the roof and sides?—We consider that the roof and sides ought to be watered.

16193. That is to say that they ought to be watered as well as the floor before you fire a shot?—Yes.

16194. I suppose the watering of the roof and sides in some cases leads to considerable expense, does it not?—I should qualify the answer which I have given as to watering the roof and sides by saying that where we fire shots in the haulage road in nearly every case the roof is rock.

16195. And therefore you can water?—Therefore we can water.

16196. But supposing you had to fire a shot somewhere where the roof was extremely friable and water would do a good deal of damage, what would you do then?—I am afraid the floor only would be watered.

16197. But at the same time that would not be a compliance with the Order. It may be that the Order should be altered, but that would not be a compliance with it as it stands. However, in that case you do practically water the roof and sides, because wherever you fire you only generally fire shots in places where that can be done?—Yes.

16198. You say in your Statement that you think in deep mines watering would have a serious effect upon the health of the miners. That has been very often stated to us, but I have never been able to obtain any statistics as to the health of the workmen in deep mines which are damp?—It is very rarely that you find deep mines are damp.

16199. On the other hand, although the damp might have a prejudicial effect upon the miners' health, if you damp you reduce the temperature?—I do not think it would be commensurate with the increased humidity.

16200. But in your mines, where deep, they are nearly always dry?—That is so.

16201. So that you have had really no experience of a damp, deep mine?—No.

16202. With regard to the mixture of non-inflammable dust with coal dust, you say that sometimes (and that is the case, naturally) the dust on the floor is to a great extent non-inflammable?—Yes. We find that is so not only as to the floor but also the sides and timbers where, as I have already mentioned, the screens are away from the shaft and we use the iron wagons.

16203. It has been suggested as a means of preventing coal dust explosions that where it was difficult to keep the mine free from dust you might minimise the danger by, so to speak, adulterating the coal dust with shale dust, or some non-inflammable dust—deliberately pouring it down into the mine?—Yes. I think that is well worth experimenting upon.

16204. You think it is possible that that might be a beneficial thing to do?—From the Report of the Courrières disaster it seemed very singular how at certain points the explosion was stopped, and the analyses that were made of the dust there showed that there was an excess of shale, and so on. Whether that was a cause or not, it certainly was a very singular coincidence.

16205. That would seem to throw some doubt upon the theory, which many scientific men hold, that a very small quantity of coal dust is rather more inflammable than a larger quantity?—Yes.

16206. Because if a very small quantity of coal dust would carry a flame, one would have supposed that it would not matter very much whether it was surrounded by the non-inflammable substances or not; if there was sufficient inflammable dust to carry it it would not, one would suppose, be rendered really less inflammable by being adulterated with non-inflammable dust. With regard to prohibiting firing during shifts, you say that where two shifts are worked it is not practicable? Could you not make some arrangement that there should be a certain interval between shifts: is that impossible?—The difficulty is this: you have two shifts working coal, which extend generally to at least 18 hours, and then there is a shift of repairers coming in, so that you have no time left out of the 24 hours.

16207. But does the shift of repairers take up the whole of the time?—The shift of repairers takes up the whole of the time; in fact they are there part of the time when the miners are there.

16208. So that if you have the two shifts you do not see how your mine could be very free from men?—No. The number would be less in the third shift, but it would very much exceed the number of 10 which has been mentioned in some of the Reports.

16209. How often do you fire shots?—Do you mean in the haulage roads?

16210. In the haulage roads or anywhere—particularly in the haulage roads, because that is the most dangerous place?—I have had the figures for one week taken out; I am sorry I have not them tabulated.

16211. Is it necessary, for instance, to fire a shot every day?—I will give you our experience; dealing, first of all, with the roadways—I take it that is the main point?

16212. That is the main point?—In the first Report we had none in the roadways in that particular week.

16213. For how long a period?—I am taking this as a week.

16214. During a whole week you did not have a single shot fired?—That is so, from the 4th to the 10th March. Then in another mine there are about four shots per month in the roadways.

16215. That would mean that it would be sufficient for your needs if you had shot-firing once a week. Could you not arrange that all the men should be out of the mine, say for an hour or half an hour, or some short time, once a week?—I think so far as our mines are concerned we should not have much difficulty in doing that, but I could not speak as to other mines.

16216. As regards your own mines, although you say it might be difficult to arrange with two shifts, still if it was considered very desirable it could probably be done?—Yes. But I may say that in all cases for some time now we have used on the haulage road a water cartridge as an additional precaution. In that case we have not found that it was quite so necessary to fire merely when the men are out of the mine. In another mine there was one shot only fired in the haulage road in a week; in another mine we had none. I should like to give you the particulars of one other case, because this is the most important. In another mine we fired over 70 shots, but those were not fired on the main haulage roads proper; they were rippings near the face—that is the mine in which we do the most blasting.

16217. Then those shots for ripping would be fired every day, I suppose?—Yes; more at the week end than at any other time. The numbers on the first four days of the week were 6, 4, 8 and 4; then on the Friday we had 35 and on the Saturday 21.

16218. So that where you have to fire in the rippings near the face it would be difficult to arrange that all the men should be out of the mine?—That is so.

16219. But at the same time that is not nearly so dangerous an operation as firing in the main haulage roads?—No.

16220. As regards the main haulage roads, you could easily arrange, if the shots were only fired once a week, that all the men should be out?—I think that could be done in our mines.

16221. And I suppose you would say it was a fairly reasonable precaution to take, would you not—that they should be out of the mine?—I do not think it is necessary if you use the water cartridge.

16222. That is in addition to these permitted explosives?—Yes.

16223. You have great faith in the water cartridge?—We have. I do not know whether you know the water cartridge. I have brought one or two samples, if you care to see them.

16224. I know about them, but I should like to see the ones you have brought?—It is simply a water-tight case which is filled with water, and the explosive is dropped down. (*The Witness produced sample of water cartridge.*) It is an old patent of a Lancashire man.

16225. (*Mr. Cunynghame.*) Does the water fill up the hole?—Yes.

16226. Then you do not put in any stemming?—Yes, we put stemming.

16227. On the top of the water?—On the top of the water.

Digitized by Google

16228. Take the case of a normal shot: how much stemming would you put on top of that?—Say 2 ft. or 2 ft. 6 in.

16229. That is rather a long stemming or long borehole?—3 ft. 6 in. is our minimum, and it goes to as much as 4 ft. We do in some cases put this water cartridge in front of the shot, and then stem the front.

16230. Why does not everybody use that water cartridge? What is the feeling against it?—I do not know that there is any particular feeling against it. It is a little more trouble.

16231. (*Chairman.*) Then your theory is that a shot could not possibly ignite coal dust if you used this water cartridge?—I do not think it is possible. We find that it stops any flame from the explosive and that it also absorbs the fumes.

16232. (*Mr. Cunynghame.*) What explosives do you use?—Saxonite principally, in the haulage roads; in some cases, ammonite.

16233. You do not use carbonite, do you?—We only use it in coal; we do not use it in the roadways.

16234. I noticed you said that the analyses of dust from Courrières could throw light on the question of mixing a certain amount of inert dust with coal dust?—Yes.

16235. But is there not perhaps a misapprehension in that, because the analyses of the dust from Courrières only give you the percentage of carbon and volatile matter in a certain amount of coal dust?—Yes.

16236. And it is shown that where the percentage of carbon was large and the percentage of volatile matter contained in the coal was small, there the explosion stopped?—Yes.

16237. But I do not think they had analyses of foreign matter mixed with the coal in the Courrières figures. I have the figures before me, if those are the ones you allude to?—So far as I understand the matter, the allegation is—and I think we cannot dispute it—that coal dust is very inflammable.

16238. Clearly. — But with regard to shale dust, I think the evidence is distinctly in the other direction.

16239. Shale dust is not so inflammable as coal dust; that is plain. But I do not think there was shale dust mixed with the coal dust where the explosion stopped, but rather coal dust containing a less quantity of volatile matter. You see the difference, of course?—Yes.

16240. I am making my point, and I should like you to answer it. I will hand you the analyses, if you would care to look at them; they are the ones to which you are referring, probably (*Document handed to Witness*)?—I am not quite sure that these are the same; probably they are. I took it from a Paper which was read by Mr. Henshaw at the Manchester Geological Society.

16241. Mr. Henshaw, if I remember rightly, took those figures and relied upon those as showing that coal dust containing a less quantity of volatile matter had been rather demonstrated by the Courrières explosion to be less explosive. We followed all that when the evidence was given?—Yes.

16242. But I do not think there was anything at Courrières to show that a mixture of inert matter with the coal dust caused a stoppage of the explosion. Although it may be probable, I do not think you can get anything from the facts at Courrières to show that?—I was rather assuming the fact that this large excess of ash was due to some foreign matter being mixed with the coal dust.

16243. No, I think you will find on looking into it that they made analyses of the coal dust and proved that the greater proportion of inert matter was actually in the coal itself?—I am sorry I am not able to speak as to that; I am merely giving my impression of what I heard.

16244. If what I have put to you is the fact, the Courrières case would not carry it very far?—That is so. I have gone a little further and roughly tested a number of dusts in our own mine. We find that in the main haulage roads, where the screens are away from the shafts and the iron wagons are used, in one case the mineral matter is 51·37 per cent.; that is off the side of the roadway; on the floor it is 60·02 per cent.

16245. That is the proportion of coal in the dust?—I should not like to say that it is absolutely coal, but that is the quantity of mineral matter in the dust.

16246. And you find that where the mineral matter is in a larger proportion it is more explosive. Is that so?—I have not made any experiments as to its explosiveness or otherwise; I was only trying to find out what difference there was in the dusts from the various roadways, as to the amount of mineral matter.

16247. (*Chairman.*) What do you call "mineral matter," because stone is mineral matter?—Our point is that on the roadways, where you prevent the coal dust forming as far as you can, we do not get much coal dust; it is more shale dust than coal dust.

16248. Yes, but shale dust is mineral; I do not quite understand what is your definition of "mineral" in this regard?—Well, it is the quantity of ash.

16249. (*Mr. Cunynghame.*) You mean you have burnt it up?—Yes.

16250. (*Chairman.*) Then by "mineral" you mean coal?—No, I do not think so; I take it this is the quantity of ash which is left on consumption of the sample.

16251. The quantity of ash which would show how much coal there was in a given amount?—No. What I want to get at is this: if you take a sample, which is very largely composed of coal dust, you then get a less percentage of ash when you consume it. When you get a sample of dust which is largely composed of shale, then you get nearly twice as much ash per cent.

16252. (*Mr. Cunynghame.*) Yes, but that does not throw any light really on the proposal to dilute the coal dust with some other inert matter?—Except that our view is—and that does happen in these particular cases—that coal dust is mixed with foreign matter in the form of shale dust, and consequently becomes less dangerous.

16253. It may be less dangerous when the foreign matter is intimately mixed up with the coal?—Yes.

16254. But simply to put the foreign matter in the form of grains it is said that a very inflammable coal may have a very different effect?—That, I think, can only be tested by experiment.

16255. You will probably agree with me that speculation may be useful, but that it does not really carry it very far?—That is so.

16256. Would you say, speaking from a general point of view as a mining engineer, that it would be practicable to require zone watering in dry and dusty mines, but with a provision that where it was, for some reason or other, impossible or inexpedient, some form of exception or dispensation might be given. Would that appear to you to be a reasonable solution—speaking of the whole country?—I should hardly like to speak for the whole country, my knowledge is not sufficiently extensive to do so; but if the exemptions were treated liberally, then I think it would. But what I wanted to point out is that, subject to experiment demonstrating that a dry zone of 100 yards would be sufficient——

16257. Or a wet zone?—I will confine myself, if you will allow me, to a dry zone; if a dry zone of, say, 50 yards on each side of the junction is found on experiment to be sufficient to stop an explosion, then I think that, as an alternative, is better than a wet zone.

16258. I quite follow; or there might be cases of exemption required possibly for other circumstances?—Yes; but I think that where the dust is absolutely cleared out of the mine, or the portions of the roadway, that ought to be considered sufficient.

16259. In view of that answer, what would you say to the following experiment; you take a short tube, say 30 ft. long; you put a quantity of coal dust in it, and stir up that coal dust well; you put a shot into that, a blown-out shot, and you get an explosion; you then send a man to sweep that tube as clean as he can sweep it, and then with two more blown-out shots in succession, with the dust that is left, you get two more explosions. Would that surprise you?—The difficulty, of course, is in getting an experiment in a tube of that sort to correspond with the actual facts in a mine.

16260. I am citing an experiment with a tube which was made the other day; if experiments like that give such results it seems to show that a tremendous amount of sweeping and cleanliness would be necessary before you would be safe with dry zones?—That is so. I think it is worth going to a good deal of trouble and expense to ascertain what would be the effect.

16261. I do not know whether you have had any experience of electric safety lamps by any chance?—I am afraid it is almost ancient history, but we did make

Digitized by Google

Mr. G. H. Peace.

21 Mar. 1907

some experiments many years ago, and they were not such as to commend themselves to us.

16262. I suppose your accumulators broke down ; it was the accumulator which was the weak point ?—No. I think the two weak points were these : in the first place you did not get so good a light as you did with an ordinary lamp, and in the second place the lamp afforded no test to the miner of the atmosphere which he might be in.

16263. Those were the two objections which you found ? —Yes.

16264. Those, I suppose, could be easily got over now ? —I do not think so. I am not sure as to the amount of light, but I do not think the other objection could be very readily got over.

16265. There are apparatus that are invented to deal with that ?—Yes ; I do not know of any that you could attach to the lamp of every collier.

16266. No, but then you would not want an apparatus of that kind attached to the lamp of every single collier, would you ?—Yes ; you see you ought to have that, because a man is working in his own place.

16267. But take the case of a man who is simply working in the main haulage road, superintending and going backwards and forwards ?—I beg your pardon, I thought you meant throughout the colliery.

16268. No, I took it from you ; you said you could not have it in every collier's lamp. I suggest you would not want it in more than half of the lamps ?—I am afraid I do not quite comprehend your question.

16269. I mean your objection to electric lamps is that you do not think it would be possible to get any gas-detecting apparatus in connection with them ?—Not applicable to every miner.

16270. I ask you would it not be enough to put them to the lamps of half the miners who go down the mine ?— I think you would have to have every lamp in the place fitted with such apparatus.

16271. What proportion does that bear to those that go down the mine as a rule ?—I should think from two-thirds to three-fourths.

16272. (*Mr. Smillie.*) You have had a very long experience of mining ?—Yes, for the last 38 years.

16273. Almost entirely in Lancashire and Cheshire ?— Yes.

16274. I suppose the longwall system is fairly general in Lancashire ?—It is.

16275. Could you tell us whether or not the mines generally are worked on the same system as your mines at Astley and Tyldesley—I mean by the system that you have almost solid coal on each side of your main haulage road ?—I do not think you could say that is by any means universal.

16276. Do you know of any other mines in Lancashire besides your own in which that system is adopted ?—I should not like to say. I have not much knowledge of other mines.

16277. May we take it that in your haulage roads— your two main slopes going away from the pit bottom— there is sufficient coal left to prevent a creep of your haulage road ?—Yes.

16278. So that on the workings shown by this plan which you have handed in, you would have no difficulty in arching certain zones on practically any part of that road where you are 300 or 400 yards from the coal face. I mean your road is strong enough to prevent a creep coming on an arch there—the coal that is left in ?—Yes, probably.

16279. I notice that a portion of the roof shown on this plan is rock ?—That is so.

16280. Then you have shale coming in on both sides of the rock ?—Yes.

16281. Does that apply to all of your seams ?—No, only to that one seam.

16282. And we may take it that in the case of the other seams it is all shale ?—All shale.

16283. What is the thickness of the shale on the roof before you get any rock ?—It varies ; speaking generally it is several yards.

16284. Why do you object to the general watering of a main road, such as you have here, where you admit there is no creep on it ?—Because our experience is that if you have wet floor you get a creep.

16285. Even where your coal is left in, on both sides of your haulage road you get a creep ?—Yes.

16286. But it would not be a very extensive creep. There is surely no danger from a creep of that kind in roads situated as your haulage roads are here ?—I should not like to say.

16287. Is it your opinion that fine dust going down the downcast shaft from the screens, where that does occur, is likely to be most dangerous as far as inflammability is concerned ?—I believe it is.

16288. We may take it, I suppose, that it is practically pure coal dust that comes down from the screens ?— Yes.

16289. You said, in answer to the Chairman, that you thought there would be difficulty in carrying down the air in dumb drifts because you would have to close up the mouth of your downcast shaft, and there would be a danger of dust still going down through the crevices and crannies at the shaft instead of going down the dumb drift ?—Yes.

16290. Have you ever known of cases in which a dumb drift was driven starting at 50 or 60 yards away from the downcast shaft and being carried forward in an archway ? —I do not know that I have.

16291. Is not the mouth of the upcast shaft closed up ?— Yes.

16292. And it is necessary to have it air-tight ?— Practically air-tight.

16293. Could not the same thing take place at the mouth of the downcast shaft, where your air was carried by a drift ?—It is possible.

16294. And do you not think that would almost make it impossible for very much dust to go down ?—It would prevent a great deal of the dust going down, I quite agree.

16295. Unless there is some other objection to it— unless you want to see the mouth of your open shaft— it would not be very expensive to drive such a drift ?— That depends upon circumstances, of course. Very often the shafts are surrounded on all sides by either railway sidings, engine-houses, or buildings of some sort, and it would depend entirely upon the particular circumstances.

16296. Where that could not be done it would be possible, of course, to carry up the sides of the shaft for 20 or 30 yards, to raise it above the dust ?—Yes either by carrying up the shaft itself or by arranging the screens so that the dust could not get to the shaft itself, and you would take the air down from some other point.

16297. If the theory is correct, that coal dust carries on explosions when they are initiated, it is an important matter to endeavour to prevent the coal dust going down ? —I quite agree.

16298. You have said that the watering of the props from time to time would shorten the life of the props. Would it be possible to have iron or steel props in certain zones where watering became necessary ?—It is possible, but in our mines we have tried them years ago, and we found they did not give nearly such good results as timber : the bars bent so much that they had only a short life, and we had to take them out again, and they were practically useless.

16299. That might be because they were not strong enough ?—No, I do not think it is a question of strength ; it depends on the roof and floor of the mine. In some mines they will stand all right, but in others they will not stand at all.

16300. We have had evidence given before the Commission as to dry zones, and it has been stated that in mines where watering would be dangerous because of the creep it should be possible to prepare zones, and to make the sides and tops smooth, either by cementing or some other method. Do you think it would be possible to make the sides and roof so smooth that dust could be prevented from collecting in dangerous quantities ?— Speaking for our own mines, the difficulty is that where you put in arching of that kind it does not last long ; the sides lift, that is to say, the floor lifts the side walls up, and you get a crush, and the whole thing is crushed into a smaller size, and then you have to take it out again; in many cases we have to take it out within two years and to renew it. That is not only an expensive operation, but a dangerous one ; we have had two men killed not very long ago from that cause.

16301. Even at a considerable distance from the face ? —Yes.

Digitized by Google

16302. Those mines are not very deep mines—I mean in the sense of depth as we understand it now. 700 yards is the depth of one of your mines ?—It is a fair depth.

16303. Another is 524 yards deep ?—Yes.

16304. Of course there are mines which go to a far greater depth now ?—Yes: we have already sunk a mine 275 yards lower than that; we are only just opening it out.

16305. The further down you go, unless the roof improves the greater the crush is always ?—There, again, you have to consider the particular roof and floor of the mine. We do not find that mere depth increases the crush.

16306. A great deal will depend upon the other strata which you have gone through ?—Yes.

16307. I am not sure whether the Chairman asked you whether or not you have a rule with regard to shot-firing. I think in your Lancashire Rules you have a rule with regard to shot-firing ?—Yes.

16308. (*Mr. Ratcliffe Ellis.*) I have before me the rules which are the same as you have; those are the new additional rules (*handed*) ?—Yes, those are the same.

16309. (*Mr. Smillie.*) You do not allow shots to be fired in the main haulage road without the knowledge and consent of the manager ?—No.

16310. Is that consent given in writing ?—I am not quite clear whether it is given in writing or not; but I am quite prepared that it ought to be given in writing.

16311. You think it would be a wise precaution to take ?—Yes.

16312. (*Chairman.*) That is to say, for each shot ?—Yes, for each shot in the haulage roads.

16313. (*Mr. Smillie.*) I should like to understand fully your objection, if you have any objection, to electric lamps. You pointed out that one of your objections, when the experiment was tried some time ago, was that it did not give sufficient light ?—Yes.

16314. I think that has been cured now, and you can get lamps which would give a better light than we have now from ordinary safety lamps ?—Yes.

16315. The other objection, which I admit is a very strong objection, is that an ordinary electric lamp without some apparatus fixed to it would not indicate to the miner the nature of the atmosphere in which he was working, as to whether there was explosive gas ?—No.

16316. But supposing a small apparatus could be attached to each electric lamp, which would indicate the presence of inflammable or explosive gas, would that remove the difficulty ?—If the lamp was satisfactory in other respects.

16317. If it was satisfactory and safe in other respects ?—Yes.

16318. Do you know of any apparatus which would indicate the presence of CO^2 ?—I do not know of any of my own knowledge.

16319. So that the apparatus mentioned by Mr. Cunynghame, while it might indicate the presence of fire-damp, would not indicate the presence of other dangerous gases ?—No.

16320. And the miner might be working in dangerous gas under certain circumstances and not know anything about it until he was overcome by it ?—That is so.

16321. That, in your opinion, is a very strong objection to any lamp which does not indicate the presence of such gases ?—Yes.

16321A. (*Mr. Ratcliffe Ellis.*) In your mines do you find more dust accumulates in some than in others ?—Yes.

16322. Which is the dustiest mine ?—I could not answer that question.

16323. Is it the deepest that has the most dust ?—I do not think that follows.

16324. You do not think it follows from the depth of the mine ?—No.

16325. It is the character of the seam ?—It is the character of the seam.

16326. Do you know of any definition of a dry and dusty mine ?—Well, it is a very wide term; that is all I can say.

16327. You are a believer in removing dust as far as you can ?—Yes, preventing its accumulation and removing it.

16328. Take the first, preventing its accumulation. In the steps which you take now do you do anything to prevent it going down the shaft ?—In our more modern collieries we have put the screens away from the shaft, and in the older ones we are now experimenting in various directions to prevent the dust that is made going down those particular shafts.

16329. What do you do underneath to prevent it accumulating there, first of all with regard to tubs ?—In the first instance, in our modern mines we use iron wagons, and that we find is a great preventive of dust.

16330. You do not find any disadvantage from their additional weight ?—No; taking the capacity of the wagon into account, the increase of weight is not very much.

16331. Do you find that since you have adopted these measures the dust has been less in quantity ?—Distinctly.

16332. You find that they are efficacious, and that you do get rid of a good deal of dust ?—Yes.

16333. What steps do you take to remove it ?—We clean out the dust from the floor and sweep the roof and sides with a brush.

16334. Is that done periodically and systematically, or is it only occasionally done ?—I must say we have only been doing it lately, since this matter came so prominently forward; and the Report I have is that since the road was first cleaned out the accumulation of dust, or rather the fresh dust, as we may term it, is very small indeed in quantity. It would have to be done periodically, but how often I could not say at the moment.

16335. Do you think it would be an expensive matter ?—I do not think so. It would be much less expensive than watering.

16336. Do you think, speaking so far as you can with regard to mines generally, and certainly mines of the character that you work, it would be any embarrassment to the management if there was a regulation that means should be taken in some way to prevent dust accumulating, and to remove it periodically ?—I think not.

16337. Have you formed any idea as to whether you can, by sweeping it, dealing with an ordinary road and removing it from the floor, get rid of sufficient, so as to ensure that what is left would not be dangerous ?—I am afraid that is a question which could only be settled by absolute experiment.

16338. You would approve that experiments should be conducted for the purpose of settling that question ?—I think it is absolutely necessary.

16339. With reference to the water cartridge which you use, is it an entirely flameless cartridge ?—We find it prevents any flame from being seen.

16340. Have you ever had a case of a blown-out shot with a water cartridge ? Is it possible to have one ?—We stem on the top of the cartridge, and I do not think it is possible.

16341. Supposing the stemming was defective, there might be, I suppose, a blown-out shot ?—If there was a blown-out shot, in my opinion, the water cartridge would prevent any disastrous results, because the stemming of water itself is much more effective than is generally supposed.

16342. (*Chairman.*) I should like to ask your attention to the Report of the Commission of 1891 on the subject of water cartridges. There is evidence by a good many people about it. The paragraph is as follows: "Mr. Dickenson knows of no defect in the water cartridge, but the other witnesses who have spoken about it agree in condemning it as troublesome to use, and on that account a source of danger." I suppose that carelessness may cause an explosion ?—Possibly that would refer to gunpowder with it.

16343. Being used with it ?—Yes.

16344. I see that there is a reference to the evidence at the side ?—I should like to draw a distinction between using that with gunpowder and using with these high explosives. There, no doubt, have been failures in the case of using it with gunpowder.

16345. It merely says that water cartridges are used, that they were found troublesome and have gone out of use. That is what Mr. Hall says ?—I do not advocate them for use in the coal face, but merely in the haulage roads.

16346. (*Mr. Ratcliffe Ellis.*) How do you use them ?—We use them in two ways; first in one case we put the explosive down inside the cartridge to the bottom and then fill the cartridge up with water and tie the neck and

Digitized by Google

Mr. G. H. Peace.
21 Mar. 1907

put that into the bottom of the hole, and then stem from that point to the outer end. In the other case we put the cartridge into the hole first and just fill the water cartridge up with water and put it in against the shot, and then stem the remainder of the hole. In both cases it seems to answer the purpose, and we have never seen any flame since we have used them.

16347. How long have you used them?—For some months now.

16348. How many shots do you fire in the course of the month in the roads?—We do not fire many in the haulage roads themselves.

(*Chairman.*) You did give the number I think.

16349. (*Mr. Ratcliffe Ellis.*) Do you find that the men have any difficulty with it?—No, we do not find any difficulty.

16350. As far as your experience goes it is a satisfactory explosive?—For use in the haulage roads.

16351. What do you do at the face?—In that case we use just the ordinary stemming.

16352. What explosive do you use?—At the face we use carbonite and in the roadways either saxonite or ammonite.

16353. Do you appoint an official shot-firer to fire both at the face and in the road?—Yes.

16354. At the face are the shots fired when the men are at work?—Yes.

16355. By the official shot-firer?—By the official shot-lighter.

16356. Is he appointed in writing?—Yes.

16357. What steps do you take to instruct him in his duties?—The manager or the under manager explains to him his duties.

16358. He has a copy of the Rules?—Yes.

16359. Do you think that it would be desirable that the rules relating to shot-firing should be printed on the back of his authorisation?—I think it would be an advantage.

16360. So as to bring before his attention what he had to do?—Yes.

16361. With reference to safety lamps, you use safety lamps in the pit?—Yes.

16362. Do you think that it would be sufficient if there was one lamp in the place by which gas could be tested or do you think that each collier should have a lamp?—I think that each collier should have a lamp.

16363. You think that he should have the means of looking after his safety and not depend upon other officials?—Yes.

16364. (*Chairman.*) With reference to the water cartridges the only important evidence against them as far as I can see is that of Mr. Thomas Bell who asked: "Have you got water cartridges in use?—(*A.*) We do not like them in our district. (*Q.*) Why?—(*A.*) Because there is too much trouble in charging the shot and there is a liability for a shot to get down so that it is not perfectly surrounded with water. There has been flame seen from those water cartridges"?—That of course would be with gunpowder I presume.

16365. (*Mr. Smillie.*) Even now you consider that those would not be so safe with gunpowder as they are with a high explosive?—No. Our view is this, my lord, that the number of shots fired in the haulage road is comparatively few, and that if there is any advantage in that which we think there is, it is a wise precaution to take.

16366. (*Chairman.*) To have these water cartridges?—Yes.

16367. Then they seem to think that occasionally this water cartridge leaks and they put in a water cartridge and leave it for hours before it explodes and all the water leaks out. So that the supposed safety from the water cartridge is rather a snare than otherwise?—That could not be done in modern practice. The man who fires the shot takes the cartridge case with him, puts it in and fires immediately.

16368. One of the principal objections to water cartridges is that they were not fired at once and when they were fired there was no water?—That might be so in the coal face but it would not be so in the haulage road.

Mr. Frank Brain, called and examined.

Statement of Witness:—

Mr. F. Brain.
21 Mar. 1907

16368A. I have had practical experience in the active management of collieries for the past 25 years, and am at present the Managing Director of the Trafalgar Colliery, Forest of Dean. I am a past President of the National Association of Colliery Managers, a Member of the Institute of Civil Engineers, also the Institute of Mining Engineers.

(1) I am strongly of opinion that the present system of examination for colliery managers' certificates conducted by 12 Boards having 12 different standards, is undesirable. This matter has been very fully discussed at large and representative meetings of colliery managers held in various parts of the country which I have attended. In every instance these meetings have expressed the desire that in place of the present system a central Board of Examiners should be appointed, whose duty it should be to prepare annually a uniform set of questions together with rules for the conduct of examination. The examination in accordance therewith to be conducted in the various districts as at present, but all upon the same day. This to be supplemented by a *viva voce* examination conducted by the local examiners at each centre. I suggest the present number of district Boards may be with advantage reduced by one half, and thus made more comprehensive.

(2) I have taken a great interest in the use of explosives in mines for many years past and also in the various methods of shot-firing. The firm of which I am the principal were the pioneers for the manufacture of electric fuses for use in mines. I have therefore followed closely for some time past investigations into the part played by coal dust in mine explosions, and am fully aware of its dangers. I realize how necessary it is to reduce by all possible means the accumulation of dust in the underground workings; I doubt, however, if it is practicable to make generally compulsory the watering of mines throughout. In some collieries the thorough watering can be done with advantage, in other cases it would be very undesirable. Where this is the case efficient and constant watering by means of zones is, I think, both desirable and practicable. I would, however, discriminate in any Rules so established. Coal dust varies very much in composition. In the second report of the Royal Commission on Explosions from Coal Dust in Mines (see Blue Book, C 7401, 1894) and the Special Report on Coal Dust in Mines made by Mr. Henry Hall to the Commission (see Blue Book 7185, 1893) this is made clear. Mr. Hall collected coal dust from the principal seams in the respective mining districts, and tested each dust separately as to its inflammability; 52 samples were received by him from 45 different collieries, and from 36 different seams. The results varied very much. The six experiments made with dust obtained from the Forest of Dean resulted in no explosion whatever being obtained, and this was so with dust from some other districts, whereas, the dust from the Albion Colliery, South Wales, and many other collieries in each instance produced violent explosions. The analyses of these dusts he gives as follows:—

	Volatile.	Coke.	Ash.
Forest of Dean	22·8 ..	30·4 ..	46·8
Albion Colliery	14·1 ..	80·4 ..	5·5

The following are extracts from the Report of this Commission:—

"Dust must be of sufficient purity, fineness, and dryness to be easily raised and to possess explosive properties."

"It is necessary to take notice of the fact that the experiments (this refers to Mr. Hall's) with dust from districts which have been practically free from explosions, such as the Forest of Dean, Somersetshire, South Staffordshire, and collieries working Anthracite, produced little more than the charring of the dust and nothing whatever in the nature of an explosion."

(3) Speaking with an intimate knowledge of the dust in the Forest of Dean Collieries, I say it is so largely

Digitized by Google

composed of shale and other foreign matter, and that the humidity in the collieries is so considerable as to render dust non-explosive. I am of opinion, therefore, that should any recommendation be made as to dealing with coal dust in mines, that exceptions should be given where it can be shown that the dust is not dangerous, and that arrangements should be made under which various dusts may be officially tested from time to time.

16369. (*Chairman.*) You have been in active management of collieries for the past 25 years and are at present the managing director of the Trafalgar Colliery, Forest of Dean. You are a past president of the National Association of Colliery Managers, a member of the Institution of Civil Engineers and also of the Institute of Mining Engineers ?—Yes.

16370. (*Mr. Cunynghame.*) You are also a member of the Committee on Bobbinite ?—Yes.

16371. (*Chairman.*) Have you had any experience in other places besides the Forest of Dean in coal mining ?—Not in residence. I have had practical experience by intimate knowledge.

16372. You have been about the United Kingdom and more or less visited it ?—Yes, rather extensively.

16373. You have visited a considerable number of mines ?—Yes.

16374. Including the fiery mines in South Wales ?—Yes.

16375. The first part of your evidence deals with the system of examinations for colliery managers' certificates. That is not a matter which is specially before us now, but if you like to tell us your views by all means do so. No doubt that is a matter which we shall have to consider and we have taken some evidence upon it already. You say that there should be a central board of examiners appointed whose duty it should be to prepare annually a uniform set of questions together with rules for the conduct of examination. In fact, your evidence is very much in accord with the evidence we have received from several other gentlemen about this examination. You suggest that the number of district boards should be reduced by one-half. I think that there are 11 now ?—Eleven or 12, I am not quite sure ; I thought it was 12.

16376. Two districts are amalgamated ?—Yes.

16377. You say about half-a-dozen ?—Yes.

16378. How would you arrange the districts ?—I think that would be a matter for the inspectors and the Home Office.

16379. Why do you suggest half-a-dozen ?—Taking, as an example, the Southern District, it is now divided between Bristol and Cardiff ; that is the district I am most closely acquainted with. It seems to me that one central board there would be more efficient than the two boards as it at present exists. My idea would be to make these boards as efficient as possible and as representative of the inspectors' districts, having in view the desirability of the *viva voce* examination covering the peculiarities of districts.

16380. You would have a Central Board of Examiners and a uniform set of questions, that is to say, you would not only have a uniform set of questions but the same examiners to examine ?—No, not the same examiners.

16381. You would not have the Central Board going all over the country ?—The Central Board would issue the questions to the examiners in each district, the examiners being arranged as now arranged. It is very much on the principle of the Science and Art Department. The Science and Art Department prepare a uniform set of questions ; those are issued to boards of examiners to districts all over the kingdom, and the examinations take place simultaneously.

16382. Considering that a mining certificate would be available in any district you would agree to that ?—Yes.

16383. Would not it be the same to have the same board of examiners, the Central Board go all over the country ?—Yes, but the difficulty appears to be this : if it is the same set of questions for the whole country, and there are six or seven examinations going on in different parts of the country, it would be impossible with one board of examiners to have those examinations upon the same day and, therefore, the probability is that the secrecy of the examinations would be inoperative.

16384. The difficulty you would feel would be a practical difficulty ?—Yes.

16385. You would not have the least objection if it could be managed that the same set of examiners should examine for every district, but you do not see how it is to be done ?—If it could be practically managed I think that it would be an advantage to have the same set of examiners, but I think that is the practical difficulty.

16386. You also add, as most people have suggested should be done, a separate *viva voce* examination for each district ?—That is so.

16387. You might have a man examined for a particular district, and he might get a very good berth elsewhere and go to another district. He would not have to pass the *viva voce* in the other district ; it would carry him everywhere. The *viva voce* examination in his own district would carry him through all the districts ?—It would.

16388. Is not that rather an anomaly ?—The *viva voce* examination is not in my mind specially applicable to that district, but it has two objects : one is for the examiners to be able to question the candidate on the result of his papers ; very often it is to the candidate's advantage and all concerned. The other point would be to meet the objections urged at present that by making the examination uniform throughout the Kingdom you are obliged to eliminate all local considerations. The *viva voce* examination which I suggest—it is now carried on and is no innovation—also gives you a certificate for any part of the Kingdom. By carrying on the *viva voce* examination I think that objection would be very largely met.

16389. Still, you might be confronted with the well-known difficulty that in one district the examiners were very lenient and in another very severe ?—I take it that the Central Board would draw up a series of regulations, part of which would be the awarding of the marks for the answering of the questions which they would propound ; that would very largely control the examination, and the *viva voce* would be simply supplementary.

16390. So that the Central Board would have the answers sent up to them and would settle the marks for the written questions after the Board of Examiners in the district ?—I should not care to lay that down ; that would be more a matter of arrangement between the Central Board and the examiners of the district.

16391. You might easily manage it in this way : have six or seven examinations, all the examinations for the year, on the same day conducted by a board of examiners, who would also conduct the *viva voce* examinations. The whole duty of the local examiners with regard to the written examinations might be to send them to the Central Board to be marked ?—Possibly.

16392. Now we come to explosives. You say that your firm were pioneers for the manufacture of electric fuses for use in mines, and that you have gone very carefully into the part played by coal dust in mine explosions, and are fully aware of its dangers. Do you think that other people are sufficiently aware of the dangers of coal dust ; for instance, the working miners themselves, the colliers ?—Are you speaking of the Forest of Dean or of any other district ?

16393. Any district.—I think they have been very much educated within the last few years, but no doubt there is still room for improvement, so far as the working men are concerned, in that respect.

16394. In the Forest of Dean you have had no explosion ?—So far as my own locality is concerned we have never had any explosion of gas or dust ; gas never has been seen. We use naked lights universally, and also we use gunpowder universally.

16395. As regards your knowledge, you have very little to say on the subject of coal dust and explosions ; that does not come within your purview. You propose to tell us your experience in other parts of the country ?—I wish to speak from a local standpoint to this extent. Knowing the characteristics of the district so well, I believe that the little dust that is met with in the Forest of Dean is quite innocuous, and therefore, in view of legislation which may probably shortly come about, we are anxious (and I am now speaking for the coalowners of the district) that this should be taken into consideration, and that such arrangements should be made that a district such as ours may be exempted from any regulations.

16396. You have been experimenting with coal dust and you find a very great difference in the composition of coal dust in the Forest of Dean and other places ?—That is so, and it has been conclusively proved by the experiments conducted by Mr. Hall in 1893 and 1894. I think I draw attention to those experiments in my notes.

16397. You give the analyses showing the great

Digitized by Google

Mr. F. Brain.

21 Mar. 1907

difference in the quantity of ash in the one case and in the other?—Yes.

16398. You propose to suggest to us that any precautions that may be necessary, and very necessary, to take in the case of other districts against explosions being either initiated or carried on by coal dust are unnecessary in the Forest of Dean?—Exactly so.

16399. You also add as regards the Forest of Dean that the humidity in the collieries is so considerable as to render dust non-explosive?—That is one of the characteristics of the district. The ventilating currents owing to the entire absence of explosive gas in the mines of the Forest are low in velocity and small in quantity comparatively speaking and very largely the collieries have steam underground, and all these things tend, together with the natural humidity of the strata, to give off a kind of dampness which is observable all throughout the mine.

16400. I suppose these mines are all shallow?—Comparatively shallow.

16401. No very deep mines?—No.

16402. And consequently no very hot mines?—No.

16403. You do not know what the effect of a damp atmosphere is in a hot mine on the health of the miners?—We have no experience of that.

16404. Is there anything you would like to say with regard to other districts you are more or less acquainted with although you speak specially as to the Forest of Dean. Is there anything that you would like to say as to the precautions that ought to be adopted in other parts of the Kingdom with regard to shot-firing for instance. Have you gone into that question?—I should like perhaps to speak to one matter that has closely interested me now for many years and to help if I could to remove what I think is probably an erroneous and rather dangerous impression throughout the country. I refer to the use of electricity for shot-firing. There is an impression abroad in the minds more especially of the colliers that it is impossible to get a miss fire, at least a shot to fire after missing with electricity. Of course it is a well known fact that the safety fuse has been known to hang fire for perhaps one hour or even more at a time and then afterwards to explode, but the general impression is that with electricity it is an impossibility. I may say that, speaking broadly, it is an extremely unlikely thing to happen, but there have been well authenticated cases of shots going off even when fired by electricity some considerable time after the miss-fire has occurred, and therefore I think colliery people should absolutely forbid their workmen to approach a shot that has missfired, whether by electricity or any other means of ignition, for some considerable time.

16405. We have had suggestions for searching for detonators. Every now and then an accident will occur, not in the collieries but in workmen's cottages, from a detonator being mixed with the coal?—I think that is largely due to want of discipline on the part of the colliery officials, because a careful account should be taken of all detonators issued by the colliery and each one accounted for to the officials of the mine, and then an accident such as that you refer to would be an impossiblity because the detonator would have to be traced—or almost an impossibility.

16406. In the same way in surgical operations it is supposed that the instruments that are used are numbered but I am afraid every now and then one is left in?—I am afraid that we are not infallible in these matters. Every precaution of that kind should be taken, but I am afraid that is not the universal rule at the present time.

16407. You think that the shot-firing rules are very apt to be thought unnecessary and they are sometimes set aside?—I would not go so far as that at all. I only speak of these special matters. I think generally speaking the shot-firing rules are very fairly observed.

16408. In the Forest of Dean as you have had no explosions and no gas do you have any rules about shot-firing other than the General Rules? I mean any Special Rules?—The ordinary rules are only applicable. We use the old system of firing gunpowder as it was generally adopted.

16409. Do you wish to make any suggestions to the Commission as to the safety of shot-firing, say, on main haulage roads, which is the most dangerous place. Have you anything to say about that. There are, as you know, special rules applicable to certain parts of the country with regard to shot-firing?—Yes. I would prefer leaving that to those who are more closely connected with those special districts. I would like to remark this, that there are various rules now in operation with regard to shot-firing, the General Rules and the Explosives Order, various rules which apply, and it would be very desirable if those rules could be all consolidated.

16410. So that you should not have legislation by reference more than was absolutely necessary?—Yes.

16411. I think that we are all agreed about that. Do you find, as a matter of fact, in the Forest of Dean that you have any difficulty in understanding what the law is with regard to these shot-firing rules. Do you think that the men have any difficulty?—As far as the Forest of Dean is concerned no difficulty whatever; our rules are so simple and the application so simple.

16412. If anybody broke the rules it would not matter because there is no inflammable dust and no possibility of explosion, so that you might go on happily in the Forest of Dean without any rules, or very nearly without any?—I do not put it as broadly as that. Many of the rules are applicable in such a part as that.

16413. Do you water?—No. Speaking broadly we do not water, but on the main engine planes we very occasionally fire a shot there, only occasionally, and in that case, there being some presence of dust, it has been suggested by the Inspector of Mines that we should only use a safety explosive, and we do that, and in that case we take precautions.

16414. You water?—We take the usual precautions. It is very seldom that we fire a shot under those circumstances; that is the exception rather than the rule.

16415. Do you call your mines dry and dusty mines?—No, we do not.

16416. According to that the rule of watering would not apply if they are not dry and dusty?—No.

16417. As a matter of fact where you have these shots on the engine planes you water?—We do as a matter of fact use the safety explosive.

16418. You do not water?—No, not habitually water.

16419. You do not water at all even for the comfort of the men?—No.

16420. There is no necessity?—No.

16421. (*Mr. Cunynghame.*) I see that you give the analyses of dust from the Forest of Dean and the Albion Colliery, and you say that the Albion Colliery dust is explosive and the Forest of Dean not so?—Yes.

16422-3. In spite of the fact that the volatile matter in the Forest of Dean is much larger than the volatile matter in the Albion Colliery?—Yes.

16424. Curiously enough, the ash in the Forest of Dean is very large, whereas that of the Albion Colliery is very small?—Yes.

16425. So that so far as these figures are worthy of reliance, it would seem that it is the quantity of ash that renders the dust non-explosive rather than the small proportion of volatile matter?—I think that would be so, in fact, the quantity of ash is very largely explainable by the great amount of shale dust that is always to be found in connection with our coal.

16426. That rather contradicts the Courrières conclusions. The French seem to think that it is the volatile matter in the dust which makes it explosive, and not the small proportion of ash?—Yes.

16427. I suppose that the whole matter is one in which it is impossible to pronounce very strong opinions at present until we have further experiments?—I think so, and I think, too, that the class of coal itself is a very important factor.

16428. You would be in favour of some regulations as to watering, zone watering especially, provided reasonable exemptions were given, where it was either dangerous or impossible to carry out. That is your general view upon the whole question?—That is my general view upon the whole question.

16429. (*Mr. Ratcliffe Ellis.*) You think that the character of the organic coal dust depends a good deal upon the character of the mine?—That is so.

16430. But that there is not sufficient information to say which mine will make a dangerous dust and which mine will make a non-dangerous dust?—The information is not very large anyhow; the information that we have at the present time does point to the fact that certain classes of coal yield much more dangerous dust than other classes of coal.

16431. What is the information from which you draw that conclusion?—Take Mr. Hall's Report to the Royal

Digitized by Google

Commission on Explosions from Coal Dust in Mines. If you look at page 15 you will find very interesting references to it by Mr. Hall. Speaking of the violence of explosions which he found to occur in connection with the trial pit of various dusts that he has tested—I think he tested something like 50—from various parts of the United Kingdom he says: "In the cases of the samples received from the Forest of Dean, Somerset, South Stafford (Great Fenton and West Cannock), Lancashire (Moston), and South Wales anthracite. The difference in the results from these dusts was, I think, due to some difference in the character of the coal seams in those districts."

16432. That was his conclusion. He could not get an explosion out of your dust, I believe?—No.

16433. What was he using, powder?—He used various explosives. He tried powder and he tried safety explosives, too.

16434. We shall be none the worse from having more information upon that subject than is given in Mr. Hall's report?—It would be most interesting to have it.

16435. Do you take any steps to remove the dust that you have?—Speaking generally, we do not. We do it occasionally, if we find an accumulation of dust on a parting or something of that kind, but we have no general system of removal.

16436. Do you find it accumulate in very large quantities?—It does not in the Forest of Dean. To begin with, our colliery yields very little dust indeed. Our workmen when they come out in the evening after their day's work, are almost as clean as when they go in. In many districts you would hardly know a man when he comes out from work. With us there is almost an entire absence of coal dust in the colliery itself.

16437. A very different state of things from what you find in other districts?—Entirely different.

16438. You do fire shots at the face?—Yes.

16439. You use powder there?—Yes.

16440. Do you find that there is much dust there?—No, very little indeed.

16441. What there is is on the haulage roads?—Yes.

16442. Have you much dust about your screens?—Comparatively speaking not. There is naturally some fine dust from the screens, but compared with other districts it is quite different from what you would find in many places.

16443. You say that the velocity of your air is very slow—that is comparatively slow?—Yes.

16444. The dust is injurious I understand when it is in suspension?—Yes.

16445. As you have a less velocity you would not have the same amount of dust in suspension, whether dangerous or non-dangerous, as there would be in a colliery where the velocity is much higher. That might be a reason of safety?—Yes.

16446. With reference to electricity have you had in your own experience cases in which a shot has gone off some time after the battery has been fired?—I have known of more than one or two instances, I will not say directly in my own experience but from correspondence with various colliery people in different parts of the Kingdom, well authenticated cases, where the shot fired by electricity has apparently missed and then some considerable time afterwards it has gone off suddenly.

16447. Can you account for that?—There are many theories advanced. I think one which is a feasible one would be this: it is a well known fact that the safety explosives, when fired, occasionally (of course this is only occasionally), imperfectly detonate, so imperfectly that instead of detonating at all they have been known to set on fire and burn. That is a well known fact which would be admitted by all experts. I can conceive that the electric fuse placed in a cartridge of explosives similar to that would set it on fire instead of detonating it as it should do and that the fire so generated would burn for a little while and then ultimately explode and go off.

16448. Have you any information as to the time that elapses between the application of the battery and the firing of the shot in those cases?—Of course there are very few cases, I am speaking now of very isolated cases and those that have come under my own notice; speaking from memory the firing of the shot would occur in a comparatively short time afterwards.

16449. Have you a regulation in your own mines that an interval must elapse between the firing of one shot and another?—Yes.

16450. Either at the face or in the roads?—Yes.

16451. What interval. Have you a fixed interval or simply sufficient to make an examination?—Under our Special Rules it is a fixed interval; I forget for the moment what it is.

16452. That is not a General Rule?—No.

16453. The General Rule is that an examination must be made?—Yes.

16454. You go further and say that it must not be made within a less period than that mentioned in your Special Rule?—Yes. I do not think that it should be at the option of the person firing the shot to go back immediately afterwards, but sufficient time should elapse before the shot is visited if it is a missfire.

16455. Do you fire your shots at the faces by an authorised shot-firer or do the men fire the shots?—Of course in the Forest of Dean, as I have already explained, our system of firing is primitive and we still adhere to the old system of firing by the workmen at the face.

16456. In the roads where you fire occasionally who fires the shot?—That would be done by our leading timberman, whoever was engaged at the time to get down the rock.

16457. Does he get the authority of any superior officer before he fires a shot or at his discretion?—He has to have an authority from the overman; he is appointed for the purpose.

16458. Has that man any instructions given to him as to the precautions to be adopted in firing the shot?—He generally would be a practical man and would understand.

16459. You assume that he understands what precautions to take?—Yes.

16460. Your system has been satisfactory; you have had no explosions at all?—No, never anything approaching to one.

16461. With reference to examinations I suppose at the present time that the Home Office could reduce the number of Districts if they thought fit without any alteration in the law?

(*Mr. Cunynghame.*) I think so.

(*Mr. Ratcliffe Ellis.*) You have to prescribe the areas under Section 23 and it seems to me that you could reduce them by one-half if you thought fit.

(*Mr. Cunynghame.*) We once considered the idea of changing.

(*Mr. Ratcliffe Ellis.*) Section 23 says, "For the purpose of granting in any part of the United Kingdom, to be from time to time defined by an order of a Secretary of State, certificates of competency for the purposes of this Act, examiners shall be appointed" and so on.

16462. What is the evil in the present system that you wish to get rid of?—The impression both with the colliery managers and with the Mining Institute is that the present examination varies so much in its calibre that it largely depends upon the local examiners.

16463. Some places are easier than others?—That is it.

16464. You know the character of the South Kensington papers, no doubt?—Yes.

16465. Would you suggest that those are at all sufficient to qualify a man for the management of a colliery?—I cannot say that I should.

16466. Do you think even in the easiest districts that the character of the question is not more suitable as it is now for qualifying a man as a colliery manager than the Science and Art Department?—That may be so, but my point would be to let the gentlemen who draw up the questions in the districts form a Central Board and draw up a series of practical questions fair to every one.

16467. The Central Board should be constituted of persons appointed from each of the districts?—Precisely.

16468. And the District Boards as at present, only a limited number of districts would exist, and they would nominate some one person to serve on the Central Board of examiners?—Yes.

16469. This Central Board of Examiners would prepare the questions?—Yes.

16470. How many examinations would you have in the course of a year?—There is some difference of opinion amongst those I represent upon that; some would suggest two or more examinations in the year and others think that one would be sufficient.

Digitized by Google

Mr. F. Brain.

21 Mar. 1907

16471. The examinations are very frequently now?—Yes.

16472. You think it would be sufficient if there were two?—Yes, one every six months.

16473. That would be no hardship on the man who failed in one district and wanted to go to another?—No, I do not think so.

16474. Six months would be sufficient to improve himself and not too much?—Yes.

16475. Then supposing that there were three examiners appointed in a district one would be nominated to the Central Board of Examiners to frame the questions, but the marks would be made by the three local men in that district?—That is a point; I was coming to that. That is a point I am not clear upon; there is something to be urged upon both sides with regard to that, but it is urged on the one hand that the marks should be fixed by a committee in London to whom all the papers should be sent, and it is urged on the other hand that the three examiners in each district should at the time of examination fix the marks.

16476. The marks would be fixed either in one way or another by persons appointed from the districts, that is, the Central Board, consisting of one representative from each district would propound the questions and the local examiners give the marks?—That is one way.

16477. The other is that the maximum number of marks for each question should be fixed by the Central Board and leave it to the local board or, rather, the local examiners it would be, to say how many, subject to that maximum, should be given to each question?—That is the system.

16478. Which do you approve?—I think myself that I should approve the latter.

16479. (*Chairman.*) I thought you approved the former, that the marks should be settled by the Board of Examiners?—I think that the Central Board should fix the maximum number of marks for each question, and that then the District Board should go through the papers and give the marks, and also hold the *viva voce* examination upon the papers.

16480. There is one difficulty in making the Central Board give the marks and look at the papers, because they will not have any knowledge of the *viva voce* examination?—That is my point.

16481. That might have some effect on the written papers. They might give an answer which might represent ignorance, and by judicial cross-examination they might find out what value ought to be given to the answer?—That is my point.

16482. (*Mr. Ratcliffe Ellis.*) You have had a good deal of experience as to this, and you have considered it from the colliery manager's point of view. Are not there many cases in which men would make excellent colliery managers who are a little nervous in answering questions on papers?—That is where the advantage of the *viva voce* examination comes in.

16483. In the locality?—Yes.

16484. That could not be appreciated at all by the Central Board?—Not at all.

16485. Taking the object to be the selection of men suitable for this particular employment, not merely theoretical scholars, but men most suitable for the management of a mine, you think that it would be best ascertained by local examiners?—Yes.

16486. You would get uniformity in the questions by having them made by a Central Board?—Most decidedly.

16487. That is the opinion which has been formed, I believe, by the Colliery Managers' Association themselves?—That is so.

16488. (*Mr. Ratcliffe Ellis.*) Would you make your suggestion as to the examinations apply to second class as well as first class?—Yes.

16489. (*Mr. Cunynghame.*) It has been argued against the setting of the paper by a Central Board that the terms that they would use would not fit the different districts. If you had a Central Board of examinations, with representative examiners from all parts of the Kingdom, would it not be easy to arrange that the papers should be set with alternative terms proper for the districts, so that a question containing a term peculiar to one district should not be addressed to somebody from another?—I see no difficulty.

16490. If you had the Central Board, those local difficulties——?—Could be readjusted as suitable to the locality.

16491. (*Chairman.*) With regard to these misfires, you say that electricity may miss fire as much as anything else. It may be hours before the electrical fuse, whatever it is, goes off?—I should like to say in the first place that I do not say that electricity can miss fire as much as anything else. I think it would be extremely rare. In the cases of other methods of firing, it occurs much more frequently; but still I say that it is even possible for electricity to miss-fire.

16492. How long miss fire for? How long is it dangerous?—I think that the danger zones in the case of electricity would be much shorter than in the case of a fuse.

16493. You say in firing these shots that they are fired under the instructions of an overman. In most of the mines now the under-manager would be the person?—I stand corrected; it should be the under-manager.

16494. Is there anything else you would like to say?—No, thank you.

TWENTY-SIXTH DAY.

Wednesday, 17th April, 1907.

PRESENT:

Lord Monkswell (*Chairman*).
Sir Lindsay Wood, Bart.
H. H. S. Cunynghame, Esq., C.B.
Wm. Abraham, Esq., M.P. (Rhondda).
Enoch Edwards, Esq., M.P.
Thomas Ratcliffe Ellis, Esq.
Robert Smillie, Esq.
S. W. Harris, Esq. (*Secretary*).

Mr. William Armstrong, called and examined.

Mr. William Armstrong.

17 April 1907

16495. (*Chairman.*) You were, I understand, the manager of the Wingate Colliery when the recent explosion took place?—Yes.

16496. You gave evidence at the Inquest?—Yes.

16497. I understand you come here with a view to give the Commission the result of your investigations with regard to the cause of the accident?—Yes, I assume that.

16498. You have, of course, read the Reports of Mr. Ruegg, Mr. Bain, and Mr. Atkinson?—Yes.

16499. Perhaps the best way of dealing with the matter will be for me to ask you to give your own version of what happened?—Shall I give it by reference to the plan?

16500. Yes (*Large Plan produced*).—There is a Plan attached to the Report, but this Plan is made on a larger scale.

16501. The Plan which you produce now shows the same state of things as the Plan which is contained in this Report, but it is on a larger scale?—Yes. You will see

Digitized by Google

there the upcast shaft and the dowcast shaft (*indicating*). The coals from this seam are drawn from the upcast shaft. At the bottom of the upcast there is a casing of wood into which the cage was drawn so as to separate the ventilation, and so as to allow us to take fresh air and use naked lights, if necessary, up to the point where the coals were put into the cage. On the surface there was a similar casing into which the cage was drawn, and it raised a sliding door for the purpose of separating the fresh air from the return air. The shot was fired at a distance of about half a mile from the pit. It was not put into a properly-drilled and prepared hole according to the Rule of thecolliery, but was placed on a ledge in order to blow down a piece of projecting rock which had existed there for 30 years.

16502. (*Sir Lindsay Wood.*) Where is that on the small Plan ?—It is there (*indicating*).

16503. What is the blue dotted line ?—That is the inspector's mark. He prepared that Plan, and the blue dotted line is meant to mark the intake air-course, as I understand it. I see it is dotted to show how far the explosion went.

16504. (*Chairman.*) The explosion went as far as the dots are marked ?—Yes. As a matter of fact we found it went a little further, when we came to examine the colliery. The shot contained 6 ounces of geloxite, which is an equivalent of about 3¾ ounces of nitro-glycerine by weight: consequently the detonation would be a very severe one indeed, and the explosion caused by the shot itself was of a very violent nature. There were only two men burnt, so far as we could see, one the man who fired the shot, and the other a man who was found in the stable way at the first air crossing.

16505. Is that the first one to the east ?—No, the first one to the west—the stable way.

16506. Some distance on ?—Yes: perhaps I can indicate it to you better by the plan which is contained in the Report: that is quite sufficient. As a matter of fact the explosion extended to there (*The Witness explained on the Plan*). The explosion knocked the man who was there all to pieces: the explosion was very violent. The box, the waggon with which he intended to load up during his shift, was smashed. The stables are marked on the Plan, in which there were 60 horses and ponies: they were not burnt, although the explosion passed down between them and the stalls and the roads, but they died from afterdamp. The course of the explosion was towards the pit: it also extended into the stable way shown on the Plan, the greatest violence being in the neighbourhood of the pits.

16507. Further on than where it turned the corner ?—Yes: it turned the corner in some curious way.

16508. It turned the corner at a sharp angle, but the greatest violence was beyond the corner, straight on towards the pits ?—Yes, straight on towards the pits: and there was no dust in the stables that we could see, or down that road, the return air-course, at all.

16509. But still the explosion went down notwithstanding ?—Yes.

16510. You could not discover any coal-dust ?—None.

16511. Was it singularly free from coal dust ?—It was singularly free from coal dust, because that way was never used at all except as the return air-course.

16512. Then would the air be going in the opposite direction to the explosion in the return air-course ?—Yes.

16513. Therefore, the explosion met the air current, and without any dust it went against the air current for a very considerable distance ?—It travelled against the return air current for a considerable distance.

16514. And violently ?—Violently, as well as with the current inside *there*: the two currents seemed to meet at that crossing which was blown down.

16515. Then the force of the explosion was sufficient to counteract this return airway current for a certain distance ?—Yes.

16516. And then in course of time they met together ?—Yes, and the explosion did not extend very much beyond that—it seemed to exhaust itself.

16517. Very little beyond the point marked "3" where the man was found ?—Yes.

16518. (*Sir Lindsay Wood.*) But there was fresh air going through your stables into the return where the two doors are ?—Yes: the fresh air which ventilated the stables passed on to the main intake.

16519. The effect of the explosion was visible in the stables ?—Yes. A large cistern which stood at the south end of the stables was blown right into the stables: *these* doors were blown out to matchwood, and also *these* doors also (*Indicating on Plan*).

16520. (*Chairman.*) Then it went straight down *there*, and it also went through the stables, parallel ?—Yes, through the stables. It did not affect this portion, the north portion, of the pit at all: that portion was not affected in the least.

16521. What is this red line; is it a barrier ?—No, it is the return air-course.

16522. Then there was a barrier there between. It could not very well have got along there at all, you say ?—That, you see, is a holing (*pointing*).

16523. So that there is no particular reason, so far as you can see, why the explosion should not have gone in that direction at all ?—No, none—but it did not.

16524. You cannot explain why it did not ?—No.

16525. On the contrary, it went at a fairly acute angle to the left instead of going at a much less acute angle to the right ?—Yes. My theory is that it received a tremendous check at the shaft here (*pointing*), especially with these casings and the narrow orifice into the pit.

16526. And it drove it back again ?—It drove it back again to a certain extent.

16527. But you cannot give any explanation of why it should have turned to the left rather than have gone on to the right ?—Except that it followed the air-course.

16528. Well, it went against the air-course, because you say the return air was coming that way.—Yes, so far down that return airway, but it followed the intake air-course as well up to that point.

16529. (*Sir Lindsay Wood.*) It entirely followed the intake air-course ?—Yes, the intake air-course so far, and the return air-course down *here*, and it blew over those doors at that crossing.

16530. Did it go from the stables on to the return at No. 3 ?—Yes; it blew those doors out, went on to that crossing and blew it down, and it came up here (*indicating.*)

16531. (*Chairman.*) As I understand, the return airway is going in *this* direction ?—Yes. There is not a very large current going up there.

16532. It went against that current rather than go along *there* where there was no current, or very little ?—Yes, very little. It followed that air-current.

16533. Although the air-current was against it ?—There is some water *here*, and I think that water would stop it, probably.

16534. Then there was a reason ?—I think that was the reason.

16535. You are now giving the reason why it did not go to the right, and you mean that if there was no water there it very likely would have gone to the right ?—Yes, it would very likely have gone to the right, but not far.

16536. At all events it did not go—it, as it were, shied at the water ?—It blew that crossing out, but it did not go very far.

16537. But you say that *here* there was no dust to carry it on ?—None that we know of. It was quite a damp road.

16538. And yet it went along this road for a quarter of a mile, or so ?—Yes—it was the accumulated force of the explosion.

16539. That carried on the flame—not only the wind, but the flame as well ?—Yes. It would receive another impetus of dust at *this* point where the shaft siding was, which would carry it on.

16540. So that there was a certain amount of dust *here* ?—Yes.

16541. And that dust was carried on very likely past the stables by the impetus ?—Yes; the flame would be in that direction. It would account for the increasing violence of the explosion as it went up towards the pit. It was fed, as it were, with air and dust.

16542. But there was nothing to feed it *here*. The dust that had previously fed it was sufficient to allow it to go on for a quarter of a mile through an apparently dustless zone ?—Yes, I think so.

16543. (*Mr. Ratcliffe Ellis.*) Was it dustless or damp ?—It was damp as well as dustless.

16544. Quite damp ?—Quite damp.

Digitized by Google

Mr. William Armstrong.

17 April 1907

16545. And that was a quarter of a mile in length?—About a quarter of a mile.

16546. (*Chairman.*) As far as No. 3 it would be a quarter of a mile, certainly?—It is a little more than two inches on the plan.

16547. But that would be only one-eighth of a mile, would it not?—Yes.

16548. (*Sir Lindsay Wood.*) Where was it measured from?—From the stable end.

16549. (*Chairman.*) And that was, moreover, merely a return blast: it was a blast which must have been, I should have thought, considerably decreased by striking against the pit and going back again?—Yes: it must have taken a turn in there: it would not come back, because the blast was going on that way at the same time: but it was fed.

16550. Although there was no dust to carry it on?—Although there was no dust to carry it on.

16551. And it carried it on by itself?—Yes: it joined the big air current. It got to *here*, where there was dust about the pit, and it got the full blast of the fresh air, which increased the volume of the explosion.

16552. Then it kicked up a tremendous lot of dust, probably, just about *here*?—Yes.

16553. And consequently the reason why it went such a long way, at all events over 200 yards, in a dustless zone, was that the dust which had previously collected was very dense?—Yes, no doubt that was it.

16554. Therefore, very dense dust apparently can go through a zone at least 200 yards in length?—Yes, that is very likely.

16555. At least your theory is that it must have done so?—I think it must have. It also came up this south return (*indicating*). It blew out the crossing *there* and came up this south return, and blew everything out *there*: it came over *here*, and that crossing was blown out (*pointing*). Then it went up what we call the drop staple in the main coal seam, up to 18 fathoms above.

16555A. That would be within a very short distance of the Lady Pit?—Yes, very close to the Lady Pit—198 yards off the Lady Pit. That staple is on the intake air-course: it is generally stagnant: occasionally it becomes as an upcast, but never becomes a downcast. The blast rushed up that staple and also up the Lady Pit into the seam above, where it burnt a man close to the pit, very slightly: it was not quite certain whether he was scalded or burnt.

16556. Then it seems to have done a tremendous lot of work: not only doing all that work going up the staple, but, having done that, it also had sufficient force apparently, to go past the stables and to carry the explosion on through a dustless zone of over 200 yards?—Yes, I believe it did.

16557. That is to say a dustless and a wet zone?—A dustless and a damp zone. There is water running down this road (*indicating on Plan*). It blew out the casings at the bottom of the Lord Pit: it went up the pit and sprung the casings at the top—that is a depth of 118 fathoms—and blew out the separation door between the two ventilating fans, one fan, a Guibal, being a standby, and the other a Waddle fan: it also went up the downcast pit, did some damage on the surface, broke several window panes in the engine-house, and the noise was heard a mile away.

16558. Was the charge a very much larger charge than is usually used for shot-firing, or was the explosion simply caused by the careless manner in which this shot was fired?—By the careless manner in which it was fired, and the quantity of explosive used: there were 6 ounces of explosive used, that is equivalent to 3¾ ounces of nitro-glycerine.

16559. A great deal more than ought to have been used?—Yes.

16560. (*Mr. Cunynghame.*) What ought the amount to have been?—With a shot like that I should think about 2 or 3 oz. would have blown out that piece of stone with that explosive.

16561. What was the explosive?—Geloxite.

16562. (*Chairman.*) About twice as much was used as was necessary to do the work?—Yes, I should say so.

16563. You have explained the course of the explosion. Have you anything to say upon that?—It also came in-bye north—along the main road from the shot along the first east way; it blew that air crossing up, and it went up into the return

16564. Do you mean the same shot?—Yes, the same shot. Then it travelled up south, blowing everything out, and all the stoppings out. There was no sign of burning or anything up *here* that could be detected in the return air-course. The force of the explosion travelled a short distance along the second east way to the next air-crossing, which is slightly damaged. It also went down into the Harvey seam 40 fathoms lower down, and slightly damaged an air crossing near to the pit.

16565. In the Report there is a section and hand sketch of the place where the shot was fired, which is marked "Plate 5"?—This plan shews the projecting piece of stone upon which the shot was laid on the line A.B. It also gives a picture showing the position after the shot was fired. It shows that beyond the disturbance caused by the heavy charge of explosive there was but little local damage in the immediate vicinity of the shot. It extended with increasing violence out towards the pit, and there was some violence northwards, but not in the same degree.

16566. Would there be more dust towards the pits?—There would be more dust; but it was fed by the air current—it received more oxygen; and there would be more dust, too.

16567. Owing to the air current being stronger towards the pit, you would get more dust?—You would get more dust.

16568. It is not that you would get more dust because the current was stronger, but you would also get more oxygen there because there was more ventilation?—Yes. The man who fired the shot was found lying with his head out-bye close beside the Greaser-way. He had evidently gone into the Greaser-way to get out of the way of the shot, and after the explosion he tried to make his way out. I do not think he was killed by the shot; he was burned, but I think he was killed by the afterdamp.

16569. As regards this shot which was fired, and which caused the explosion, I understand from Mr. Ruegg's Report that, although this man Maddison, who was killed, and who fired the shot, was an experienced man and had a special authorisation, Mr. Ruegg considered, and you agreed with him, that the substance of the General and Special Rules and Orders as to shot-firing should be printed conspicuously on the form of authorisation given to each shot-firer, so that the shot-firers may always have before their eyes when they fire a shot the knowledge of what they ought to do?—That is so. That is being done now.

16570. Otherwise, you simply give a man the authorisation, and if he happens not to know the Rules or to have forgotten them, there is nothing to tell him what the Rules are?—With this exception, that when he has the authorisation given to him the Rules are read over to him and explained to him by the under-manager.

16571. Whenever you give a man an authorisation, the under-manager gives him a lecture, as it were, upon the Rules?—Yes. Not only that, but every three months all the firemen are brought into the office and the Rules are re-read to them.

16572. But still, you consider it would be an additional precaution, and one which might well be adopted, to print on the back of every authorisation the Rules relating to shot firing?—Yes, or to give the Rules to them not in the authorisation but as a separate book, and to draw up a code of Rules, condensing the present Rules under the Act which require condensation, making them plain and intelligible so that each man may have them.

16573. You think that accidents may happen by reason of the Rules being too voluminous?—I think so, certainly. I do not think the men understand the Rules.

16574. That is a different matter?—Yes.

16575. Therefore, you say there are two points: first of all, that the Rules ought to be put before the men in a way in which they can understand them, and, secondly, that, in order to make it absolutely certain that a man, even if he has forgotten a Rule at the moment of firing the shot, should be able if he pleases to bring it to his mind, he should have the short Rules printed on the back of every authorisation?—I do not say that: I think it would be plainer if he had them separate.

16576. I think you say so, according to the Report?—Yes, that is so there, but I have rather changed my view upon the matter since I have considered it further.

16577. You say now that it would not be a good thing to print these Rules on the back of every authorisation, but that everybody ought to have a book of these Rules as abstracted by you?—Yes.

16578. And that would be better than leaving a man

Digitized by Google

to gather what the Rules are from reading the whole voluminous list of them ?—Certainly.

16579. (*Mr. Ratcliffe Ellis.*) And the other Rules all mixed up together ?—Exactly.

16580. (*Chairman.*) You would not only take out of these Rules everything which had to do with shot-firing and put them together, but you would do more than that—you would yourself, even when you got those Rules together, shorten them ?—Yes, shorten them.

16581. And make them, as you consider, more intelligible to the workmen ?—Certainly. I may say I am doing this in conjunction with Mr. Bain, the Inspector: I am asking his approval for all this.

16582. Mr. Ruegg, in his Report, lays very great stress in connection with this accident upon miners refusing to acknowledge the great danger that there is simply from coal dust when it is unmixed with any firedamp or anything in the nature of gas ?—I do not think it has ever been clearly brought before them.

16583. Then you agree, probably, with Mr. Ruegg that the average collier does not at all realise the dangers which lurk in coal dust alone ?—No, I do not think he does. They did not up to this explosion: I think they are now beginning to see it. Another matter I may mention is this: I think the expression "safety explosives" is very misleading, and I think it is probably on that account that the man in the Wingate explosion used that explosive for his shot, thinking it was a safety explosive; because he was certainly told that coal dust was dangerous, and all the men are told so. The words "safety explosive," I say, are wrong; if you used the expression "high explosive" it would be better.

16584. You think when a man sees the words "safety explosive" he thinks "It is all right and I can do what I like with it" ?—Yes.

16585. (*Mr. Ratcliffe Ellis.*) Where do you get the words "safety explosive" from ?—Is it not mentioned in some rules ?

(*Mr. Cunynghame.*) No, it is an invention of some of the vendors, who use the expression "safety explosive" the moment an explosive has passed the Home Office test. We have again and again pointed out that there is no such thing as a really safe explosive, and we have endeavoured to combat the use of that term as much as possible. The expression "permitted explosive" is the proper one.

(*Chairman.*) The words "safety explosive" do not appear in the Act of Parliament at all, do they ?

(*Mr. Ratcliffe Ellis.*) No, it is the manufacturer who calls it a safety explosive.

16586. (*Chairman.*) Have you anything to say as regards any light that may be thrown by this accident on the question of watering mines ?—It is a very complex question. This seam might be watered in certain sections, not in others. It would certainly cause great danger to the roof.

16587. But supposing it was watered where you could water it without causing danger to the roof, do you think it would be, if I may say so, worth while to water it ? Do you think that the effect of watering it would be very considerable in stopping the course of an explosion ?—I would not like to give an opinion upon that, because it is difficult to say what length of watered way, if any, would stop an explosion. For instance, you might say 100 yards or you might say 200 yards of saturated road would stop an explosion, but neither might do it.

16588. It has been suggested that we should make experiments to endeavour to find out what length of zone would probably stop an explosion ?—I think that is very advisable.

16589. I understand your system of watering was commented on at the inquest ?—It was not a complete system of watering at all; we only watered the floor.

16590. We have had some evidence given before us that watering the floor does a great deal of good, because in course of time the dust that collects above the floor gets blown down on to the floor, and if you water it, it is easily dealt with ?—Provided the floor is not easily disturbed by water; some floors are easily disturbed by water.

16591. I was merely calling attention to the question of whether it was necessary to water the sides and roof as well as the floor ?—I should say so, if you water at all.

16592. You think you ought to water all ?—Yes. We are brushing now in the Harvey seam.

16593. How far is brushing efficacious ?—This is the seam in which we are brushing the dust (*pointing out on Plan*). It is the Harvey seam, the gas coal seam; we have brushed certain lengths. We are brushing all the way in *this* direction. We have been making some tests, and we find that 649 yards from the downcast shaft there is 0·289 of an ounce per square foot.

16594. A little more than a quarter of an ounce per square foot ?—Yes.

16595. That would represent, I suppose, almost the maximum of cleanliness that you could get ?—We could get a little nearer than that, I think.

16596. Would that be dangerous ?—Well, I am not quite sure whether it is not more dangerous to have a little dust than to have much.

16597. That is the question.—My own opinion is that it is more dangerous.

16598. You think it is absolutely more dangerous ?—Yes.

16599. Then you think that this quarter of an ounce of dust in a square foot would be dangerous ?—I think so.

16600. Brushing that only removes the dust to such an extent as to leave a quarter of an ounce in every square foot would not be enough ?—Pardon me, that is not what we left; that is what we took off. We brushed it off perfectly clean into a pan.

16601. And that is what you found ?—That is what we found. We wanted to see exactly what the result was.

16602. (*Mr. Ratcliffe Ellis.*) How long do you think there had been that accumulation ?—I should think 15 years.

16603. (*Chairman.*) Have you tried to find how much dust would still be there a week after you brushed it ?—Ten weeks after, there is 0·117 of an ounce re-deposited.

16604. Would that be sufficient to carry on an explosion, that is, about one-tenth of an ounce ?—I do not think it would.

16605. You think about one-ninth or one-tenth of an ounce would not be sufficient ?—No.

16606. (*Mr. Ratcliffe Ellis.*) Why do you think a small quantity of dust would be more dangerous than a large quantity ?—Because where you have a larger volume of dust, you have so much more to oxydise and to form the flame and explosion and a large quantity would tend to choke the explosion.

16607. (*Chairman.*) Then your theory is what we have heard before—that it requires a certain amount of oxygen to be mixed with the coal dust in order to produce an explosion ?—I think so.

16608. And if you have a large amount of coal dust, the small quantity of oxygen is mopped up by the coal dust and the remaining coal dust is inert, and it rather prevents an explosion by reason of diluting the dust ?—Yes.

16609. That is to say, it would be pretty much the same thing if you mixed shale dust, or anything of that sort, which was utterly inexplosive—so long as you have sufficient coal dust to mop up all the oxygen there is it does not matter how much more coal dust you have ?—I think that is so.

16610. (*Mr. Ratcliffe Ellis.*) Would it burn ?—I do not think it would; it would put the flame out; it might smoulder.

(*Mr. Cunynghame.*) It is like an excess of gas; that acts in the same way; if you have a certain amount of gas in the air, instead of making it more inflammable, after a certain amount it begins to make it less inflammable.

(*Mr. Ratcliffe Ellis.*) Yes, but the gas would burn, and coal dust would not.

(*Chairman.*) That is to say, that the excess of coal dust that is not reached by the oxygen would be a non-inflammable substance, like shale or a similar dust, and would tend to dilute it.

(*Mr. Ratcliffe Ellis.*) It would not be explosive; there would not be sufficient oxygen left to explode what coal dust there was ?

(*Witness.*) Yes.

16611. (*Chairman.*) It is rather a question whether the excess of coal dust would make a difference. I do not know whether it has been proved sufficiently what would be the result of having an excess of coal dust beyond the amount reached by the oxygen. I think many people rather agree with you that it would dilute it and make it less explosive ?—Yes.

Digitized by Google

Mr. William Armstrong.

17 April 1907

16612. (*Mr. Cunynghame.*) I do not think that has been tried by experiment.—It is very important to do so.

16613. (*Chairman.*) So that in that case, if you had an extraordinarily dusty seam from which it would be extremely difficult to remove the dust, you might let it remain there and it would be better that it should remain there?—Yes.

16614. (*Mr. Cunynghame.*) And you would be positively doing harm by taking away the dust?—That is possibly so.

16615. (*Sir Lindsay Wood.*) You say that the amount was 0·117 oz. per square foot: is that per square foot of area of the way?—Yes.

16616. Not per square foot of sides and top?—Of everything—that is the area of the surface from which that was taken.

16617. The area of the surface—not the area of the way?—Not the area of the way.

16618. The area of the surface, top, bottom and sides?—Yes.

16619. And not the area of the actual gallery?—No.

16620. (*Chairman.*) Then this seam is dry all through?—In some places it is wet; here it is rather wet (*pointing on Plan*). There are wet places in this seam.

16621. Then your theory is that if you get it down to as little as one-ninth or one-tenth of an ounce per square foot, that small amount of dust would not be sufficient to carry an explosion?—I do not think it would.

16622. (*Mr. Ratcliffe Ellis.*) There would be no improvement in the character of the dust by removing oxygen. You see the way in which the dust is rendered harmless is that where there is an excessive quantity of dust or a very large quantity of dust, it absorbs the oxygen, and therefore there is not enough air to make the dust explosive; but if you remove the dust in large quantities and leave a small quantity there, you do not get the benefit of that?—No, but I think the small quantity would be insufficient to cause an explosion.

16623. (*Sir Lindsay Wood.*) Could you tell me the proportion of an ounce of dust that would be in the sectional area of the way? You have given it to us per square foot on sides, roof and top, but not for the whole through which the air is passing?—No, I am afraid I could not tell you that; I have not the particulars here.

16624. You have not the size of the ways?—I have not. These are the dimensions of the surfaces only. I could easily send that information to you.

16625. It might make a great deal of difference. What we want to get at is the quantity of dust in a square foot of space through which the air is passing?—The sectional area.

16626. Yes, the sectional area?—That I can easily send you.

16627. (*Chairman.*) That would depend upon the size of the airway?—Yes.

16628. (*Sir Lindsay Wood.*) It would depend upon the size of the airway, because it is the space in the centre through which the air is going?—We fired 100 shots in this engine-plane one week-end without the slightest trouble.

16629. (*Chairman.*) Is there anything else you would like to say about the Wingate explosion?—No, excepting this, that if the rules are carried out they are ample and abundant to make every pit as nearly safe as a pit can be. We have had 60 years of immunity with large numbers of shots fired every day.

16630. Do you agree that your system of watering is inefficient, as Mr. Ruegg suggests?—Yes, I think it is.

16631. And it might be done better?—It might be done better.

16632. And it will be done better?—It will be done better certainly in regard to that particular point, in the Low Main seam. But I cannot say that I dare water this Harvey seam. The roof is very dangerous and the coal is very easily affected by water; we have found that by experiment.

16633. What system of watering would you consider would be most efficacious where you can use watering at all?—If it comes to be a question of watering, I would suggest the wet zone—that is the only thing I can suggest.

16634. Then would you specially prepare a wet zone by roofing it?—Yes, I would certainly.

16635. You would do that in your colliery?—Yes.

16636. In many cases that would not be necessary?—That is so. Of course where necessary in a seam like this, it would have to be done.

16637. You have had nothing to indicate as yet whether a dry, dustless zone stops an explosion as well as a wet zone?—No. I would also suggest that it would be well to test by experiment the effect of an explosion of that amount of explosive in a close drift. Six ounces of nitro-glycerine is a large quantity of explosive.

16638. Was this particular operation one which necessitated a very much greater strength of explosive than would usually be used in a mine?—No, for this particular shot fired by this man it was not necessary; and besides that the shot was put in the wrong place, and the reason he used so much explosive was to allow him to do his work without drilling a hole, because he had no drill there with him.

16639. Would there be any blasting operations that would require so much of this geloxite?—I cannot think so, except that in the workings, where we have very heavy frames and hard stone to blow down, they might use a very big breaking-down shot.

16640. It might be necessary to do so?—Yes.

16641. And where that was blown out, there might be an explosion in the same way as there was here?—Not where it was used. It could not be used in the engine-roads at all. There is no necessity for blasting in any of those engine-roads—all the blasting is finished.

16642. But still, there might be occasions in other mines when you might have to use as much explosive?—I should hardly think on an engine-road it would be necessary; that is a terrible charge. Of course, with precautions of watering it would be different. I do not believe that had that shot been properly drilled, it would have caused the explosion.

16643. Was it watered?—No, he did not water it at all. He did not use the proper precautions. It was because the mine was always considered to be a wet and a safe mine.

16644. This General Rule requires you to water in dry and dusty mines. Do you consider your mine is not a dry and dusty mine?—We always treat it as such.

16645. Then it was clearly a contravention of the Rules not to water, to begin with?—Certainly.

16646. Is that Rule constantly contravened in your mines, so far as you know?—No, it is the only shot that I know of being fired on an engine plane in that way. All the other shots were done properly and done at the week-end with everybody out of the pit on firing the shot except two or three men, and the roads are not only brushed thoroughly on each side of the shot for 20 yards, but also watered.

16647. So that you say for a fact you know it is not a common thing for this Rule with regard to watering to be disregarded in shot-firing?—Certainly not.

16648. (*Mr. Cunynghame.*) Is there any point, other than what you have stated, on which you differ from these Reports of Mr. Ruegg and Inspectors Bain and Atkinson? Do you wish to make any further observation on any point?—I do not think so.

16649. I am not inviting you to do so, but I merely wish to know?—With this exception, that I consider the Rules are ample for all purposes of safety, if properly observed.

16650. I do not think that the jury or any of these gentlemen attributed blame to the management of the colliery here?—No.

16651. On the contrary, I rather think Mr. Ruegg praised it on the whole. I think there is a sentence in his Report to that effect, if I remember rightly. It is on Page 10, where he says: "The colliery appears to me to have been admirably managed, and it cannot be treated as a reproach against either officials or men that they did not more effectively guard against a danger of which they were in ignorance." Now I want to ask you a little more about those explosives. How is the geloxite obtained; do you provide it or do the men buy it?—We buy it. We buy all explosives ourselves.

16652. You charge the men on account for what they use?—Yes, we charge them for what they use.

16653. Who fixes the amount of geloxite that is to be used in a particular blasting hole?—It is left a good deal to the judgment of the shot-firer. The shot-firer puts the charge into the hole.

16654. Would it not be wise to have a limitation as to the amount, and a provision that it is not to be exceeded except in case of a written order?—I do not think that would be possible, because so much has to be done at night in the way of shot-firing to get the roads ready.

Digitized by Google

16655. But do you use shots in the coal as well ?—Yes.

16656. Would it not be practicable to say that nobody should use more than a certain number of ounces in bringing down coal ?—I do not think that is at all necessary. We have never found any difficulty in that respect or suffered from it in any way.

16657. The men never use excessive charges in bringing down coal ?—No, because their attention is immediately brought to the fact that it would shatter the coal.

16658. There was a good deal of evidence given before the Committee on Bobbinite, to the effect that the charges used were rather too large. People seemed to be in ignorance, particularly in the case of geloxite, and high explosive like that, as to the considerable effect which the explosive would produce, and there was a tendency to use rather higher charges than necessary ?—These high explosives are all made up in shots, and you cannot break them.

16659. No, but you can have them supplied in any size that you please ?—We have them in different lengths. Each coal seam as a rule takes a certain shot to bring the coal down, and we very seldom vary from it ; for instance, in the long-wall face it takes a certain shot, and that is left to the judgment of the firer ; he will not use more than he thinks fit to bring down the coal. I do not think you could put that limitation on.

16660. That is your view, but I will take now another point: in many collieries the men buy their own explosives ?—I believe so.

16661. Have you any experience at all of that system ?—They used to do so formerly, a great many years ago, before these "safety" explosives came out.

16662. Do you not think that is a bad plan ?—I think that is a bad plan.

16663. Used they to buy them merely from the local shops how they liked ?—I think they used to do so formerly.

16664. I have heard of cases of, say, sending a little girl round for sixpennyworth of tea and a couple of cartridges ?—Yes, I think that is so.

16665. That has been done in cases ?—Yes.

16666. As a Mining Engineer would you absolutely condemn that kind of thing ?—Yes, absolutely ; it is wrong.

16667. When you supply explosives to the men you charge them a certain fixed sum for the quantity which they use. How is it that you do that ?—Each man says what shots he requires when he goes to the explosives store. We do not charge him the full price ; we generally charge him about the price that powder would be.

16668. You are aware that under the Truck Acts you would be prohibited from making a profit upon the sale to the men ?—Yes.

16669. And you do not desire to make a profit ?—No ; we charge them even less than we pay.

16670. I suppose the making of that charge is to be defended on the ground that it tends to make men more careful and to prevent them recklessly using the stuff, as they might do if they got it for nothing ?—Exactly.

16671. So that you make some charge for the explosive, but you agree that it ought not to exceed, or even to come up to, the total value of the explosive ?—Well, it need not necessarily do so, but it must not exceed the total value.

16672. With regard to the maintenance of discipline and the personnel of the mine, are there any lectures given in your neighbourhood to which the men could go, and which are of a simple character such as would interest them ?—I am afraid there are not.

16673. Is your colliery away from a village in a lonely valley, or something of that sort ?—No, it is a large village in itself : it is just a country village.

16674. What sort of amusements do the men have in the evening to go to ?—The men have none whatever. The boys amuse themselves with football chiefly.

16675. But what amusements have the men ?—None at all.

16676. In a village like that, with no amusements in the evening, I suppose a lecture which was not made too technical but kept pretty simple would be of interest ?—I think it would be very interesting, and would attract them.

16677. And probably to have lessons as to First Aid to wounded, rescue, and so on, would be good ?—With regard to that we have a very efficient arrangement.

16678. But you would go further and have, I suppose, lectures with magic lantern illustrations for the boys and young men ?—Yes ; more especially in the winter months. I think it would be of very great benefit.

16679. What County Council area is this in ?—Durham.

16680. Have they done anything in the direction of helping you at all ?—Nothing. I think that is very much left out of consideration by the people.

16681. It has not been tried, so far as you know, anywhere around ?—No.

16682. Then part of the "beer money" for this education has not come your way, apparently ?—No. The men have their own Workmen's Clubs, which some of them resort to, but one of them unfortunately is a drinking club ; that is to be deplored.

16683. (*Sir Lindsay Wood.*) Do you fire many shots in the main wagon ways ?—No. We have not used any shots in the main engine roads or main air roads for two or three years.

16684. Then nearly all the shots which you give an account of are in the actual working of the coal ?—Face shots.

16685. And you do not get dust explosions in the face ?—Never. In fact it is very rarely that we see flame from these shots ; I have no reports of it.

16686. Do you think it would be any hardship on the men working the coal if all shots in wagon ways were prohibited ?—Do you mean in main engine roads ?

16687. Yes ?—I do not think it would be. They should not be fired except under the precautions we use now.

16688. Do you think they should be more stringent ?—I do not think I should go beyond what we have now.

16689. (*Chairman.*) Then you would not prohibit them ?—I do not think I would. It is sometimes necessary, and I think under the regulations laid down it is perfectly safe.

16690. (*Sir Lindsay Wood.*) The fault of that is that they are not always carried out. They should be more stringently adhered to, at any rate ?—I think so, and more stringently worded. I think the penalty should be very great for any breach.

16691. (*Chairman.*) Then you do consider that there ought to be some sort of modification of the Rules if you think they ought to be more stringently worded ?—Certainly. I am dealing with that.

16692. In the Epitome of Rules which you are drawing up you are strengthening them ?—Yes.

16693. It is not simply an Epitome of Rules which you are drawing up, but you are drawing up a Code of Rules for your own mine which are somewhat stronger than they are at present ?—Yes, I think so.

16694. (*Mr. Enoch Edwards.*) The Chairman put it to you that the average collier does not realise the danger from coal dust ?—I do not think he does.

16695. Do the officials of the colliery ?—Yes, I think so. They have been lectured upon it.

16696. Did they realise it before this explosion ?—Yes.

16697. Because the means to be adopted in order to avoid an explosion are rather with the officials than with the men, are they not ? The Rules laid down to avoid an explosion are Rules to be observed and carried out by the officials and not by the men ?—I take it by both.

16698. The Rule as to watering the face is a Rule for which the officials of the colliery are responsible ?—We do not water any face.

16699. But in carrying out the Explosive Orders, which are meant to meet this danger of coal dust, that obligation is on the officials of the colliery ?—Yes.

16700. Would it be true to say that they do not realise the danger of it ?—No, I am certain that they do realise it and did realise it before the explosion.

16701. You think that the officials do realise it ?—Yes, there is no doubt about it.

16702. Have you yourself had much experience of explosions apart from this one ?—Yes.

16703. I understood you to say that you thought there was less danger from a greater quantity of coal dust ?—I think so. It is merely a theory. I think it chokes the fire.

16704. You would have some sort of knowledge of the explosions in the sixties and seventies ?—Yes ; you are

Digitized by Google

Mr. William Armstrong.

17 April 1907

speaking of the Oaks Colliery at Barnsley. I remember something of that, but I was not there at the time.

16705. It was not considered then to be a serious thing to have 8 or 10 or 12 inches of coal dust lying about the roads everywhere?—No.

16706. So that they had tremendous quantities of dust?—It was a dusty seam, from what I know of it.

16707. The explosions were very serious?—The explosions were very serious; there was a great deal of dust.

16708. Then how do you harmonise that with your theory that the greater the quantity of coal dust the less the risk of explosion?—But the conditions were different in the Oaks Colliery, because, with a lot of dust, there was a huge quantity of gas present.

16709. And that would be a qualification?—Yes: I say that if there is gas present there is no limit to it.

16710. In the questions put to you you were rather treating the question of dust itself?—I was.

16711. So that it would not be correct to say that that would apply in all collieries?—I do not think it would—if there is gas present.

16712. It is noticeable that in those days there was an enormous quantity of coal dust, and they had terrific explosions?—Yes, I think they had.

16713. Explosions of much greater magnitude than take place now?—I think they were assisted by gas, and were therefore more violent. The ventilation was not as good.

16714. You said you thought that if the rules were carried out they were sufficient. What do you mean by that?—I mean that the Rules as framed under the Mines Act, if observed alike by masters and men, are amply sufficient for all purposes of working a colliery in safety.

16715. If the rules are carried out?—Yes.

16716. What rules were broken in this case?—The Shot-firing Rules. First of all the man broke the rule that you are not to fire on any engine-road.

16717. (*Mr. Ratcliffe Ellis.*) Except under certain conditions?—Yes, You will find that set out in the Report.

16718. (*Mr. Enoch Edwards.*) You are very emphatic when you say that if the rules are carried out they are sufficient?—Yes. If that man had not fired that shot there and contravened that rule, the accident would not have occurred.

16719. There were 24 men killed by that act?—Yes.

16720. Could you tell the Commission how you are going to have the Rules carried out? The object, rather, of this Commission is to try to find out how it is possible to avoid the destruction of human life in mines. Can you tell us, if those rules are sufficient to prevent explosions, how they can be carried out?—Well, I cannot account for human fallibility. It is a question of human fallibility: and I suppose the same applies to all dangerous trades—engines, railways, and everything. The most stringent rules are sometimes broken.

16721. What was this person who was in charge—a shot-firer?—He was a shot-firer: he held a shot-firing license. As a rule the same man who has the detonator is not allowed to have the charge. But this man asked his mate for the charge box, and took them both in with him. That is infringing our local rule.

16722. This man was 24 years of age?—Yes, a young man.

16723. Had he any authority from any one to fire shots in this particular haulage road?—No.

16724. It would be known that they were firing shots in the haulage road?—No.

16725. Was this the first shot they had ever fired in the haulage road?—Yes, the first for 20 or 30 years.

16726. Had he been instructed by anyone to get this rock down?—No, the rock had been there as long as the haulage road: he had no instructions at all. It was not in the way: why he did it I do not know.

16727. You have used the term "safety explosive." Mr. Cunynghame reminded you that it should be called "permitted explosive," but since then you have yourself used the term "safety explosive"?—Yes.

16728. He put questions to you about men being careless with regard to the use of permitted explosives, and asked you whether you charged the men for them. He was suggesting that if there was no charge and if they got the explosives free they would be likely to be more careless. I want to ask you who is responsible for the amount of charge which is put in a hole?—The fireman.

16729. So that the question whether the colliery company or the workmen pay for it would not have any effect?—Yes, because the man pays for it.

16730. But if the fireman is the person who is responsible for the amount of charge that is put in (I understand that is what you mean) then it is not a question as to whether the workman pays for it or his employer?—It would prevent him putting in too much, and he would know from experience how much would bring the coal or the stone down.

16731. Who would?—The fireman.

16732. No. I understand you to say that the fireman is the person responsible for the amount of charge put into a hole?—Yes.

16733. Now you say he is prevented from putting in too much. Who prevents him?—I may tell you that the coal hewer takes his charge in, and he does not have anything to do with it. The fireman puts the charge in and stems the hole, but he takes the amount from the coal hewer; he does not take it himself.

16734. The fireman is responsible for the amount put in?—Yes.

16735. So that it would not make any difference whether the company pays for it or the man pays for it, with regard to the amount that is put in?—That is so.

16736. Mr. Cunynghame was suggesting to you that if the man had to pay he would be more careful, but I was pointing out that if the company pay there would be nothing in that point. In most well-managed mines in which they deal with high explosives I think that is so?—Yes. It ought to be so.

16737. (*Mr. Ratcliffe Ellis.*) It would seem from this Report that before the explosion which you had at Wingate you were rather sceptical as to whether there could be an explosion purely from dust?—Yes.

16738. Have you come to a decided conclusion upon that question now?—Yes, most decided.

16739. You think there can be?—Undoubtedly.

16740. Your view is that, dealing with a dust explosion and assuming an entire absence of gas, an excessive amount of dust is less dangerous than a small amount of dust?—Yes, that is my feeling in the matter.

16741. But you can never be sure, I suppose, whether there might not be some gas which might play a part in an explosion?—I would not like to be sure either way.

16742. Do you think it would be safe to risk in any case having a large accumulation of dust in order to get the benefit of that state of things if it is purely a dust explosion, but which would bring about a very much greater danger if there happened to be any gas present?—Certainly, I think it would not be safe to rely upon that.

16743. I see that Mr. Ruegg in his Report on the Wingate explosion says: "My strongest representation, however, is that all main haulage roads should as far as practicable be kept clear of dry coal dust. I think this should be made compulsory." Do you agree with that?—I think if it can be done it would be safer.

16744. Then on the whole you would agree that it is desirable that, so far as practicable, dry coal dust should be removed?—Undoubtedly.

16745. Have you formed any view as to whether there is such a difference in the character of dust and its inflammable or explosive character as to justify any exception from that General Rule with regard to any particular kind of coal dust?—I think if it is fine enough any coal dust will cause an explosion.

16746. So that you think it would be conducive to safety if some general regulation were made that so far as practicable accumulations of dry dust should be prevented?—I should put it in that way.

16747. I see the inspectors in their Report on the Wingate explosion say, on page 33: "The explosion died out in all directions with the cessation of the supply of coal dust." I gathered from what you were explaining to the Chairman that that was hardly so—that in one case it left the dust area and followed an area that was not only pretty clear of dust but also damp?—Yes. What I say is this, that the force of the explosion was caused by the sufficiency of air. It took the line of ventilation against the current, and the very fact of its doing so increased the force of the explosion.

16748. Have you the Report before you?—Yes. I rather differ from what they say there.

16749. They distinctly say, "The explosion died out in all directions with the cessation of the supply of coal

Digitized by Google

dust" ?—My feeling is that it will not go along with the air; it does not get fed quickly enough with oxygen. In all explosions that I have seen, the greatest violence is against the air current; for instance, take the Seaton Colliery explosion in 1871, where the accident was caused by an explosion of gas at a fall; it was nearly two miles from the pit, and it went out against that air current, which was a very large one, and caused the most frightful catastrophe all about the pit bottom and blew out all the stoppings; but 100 yards in, on a road which was equally dusty, it hardly went at all and produced no explosion. I say it goes against the current.

16750. Then you do not agree with that paragraph in the Inspectors' Report, that "The explosion died out in all directions with the cessation of the supply of coal dust" ?—I do not think so.

16751. Will you explain shortly why you disagree with that conclusion in connection with the Wingate explosion. You think that this is not the result—that it did not die out in all directions with the cessation of the supply of coal dust ?—Yes.

16752. Will you describe what you think took place in the mine on the level by reference to the Plan. I do not know how you can describe it ?—I cannot very well describe it; it is very difficult.

16753. From *this* point to *this* point was there dust along there? (*Indicating on Plan.*)—I should not like to say.

16754. Which is the point at which you say it followed the non-dusty road and departed from the dusty road in other directions ?—It went through the stables, through that return air course, and broke down there. (*Pointing.*)

16755. It went down the road past the stables ?—Through the stables.

16756. It went down the road through the stables which was not dry or dusty, and it left the dry and dusty road. I rather understood from you that it did not go along the dry and dusty road, but it left it *there* and went along a road that was not dry and dusty ?—Yes; it was dusty down to about *that* point. (*Indicating on Plan.*)

16757. (*Chairman.*) Was it dusty through the stables ?—Yes, but not through the intake. It went down the intake as well.

16758. (*Sir Lindsay Wood.*) Might not the reason of the explosion going through the stables be due to the force of the blast at the bottom of the shaft requiring a space through which it is bound to go whether there is dust or no dust ?—Yes, that is exactly what I say.

16759. (*Mr. Ratcliffe Ellis.*) And the result of the air in the downcast was to send it in a different direction. You say it did not follow the dust because the blast in your view was driven in a different direction by the air coming down the downcast shaft ?—Yes.

16760. (*Chairman.*) Then notwithstanding that the blast carried the explosion through more than 200 yards of watered or dustless zone, as I understand ?—Yes.

16761. So that if an explosion is very forcible indeed a watered and dustless zone would not stop the explosion even if it was 200 yards long ?—It might not.

16762. It might not if it is violent enough ?—If it is violent enough and in proximity to the greatest force of the explosion.

16763. (*Mr. Ratcliffe Ellis.*) I see there is a paragraph in the recommendations contained in the Report saying: "Many mines in which the deposited dust on the main haulage roads is as great if not greater than was the case at Wingate probably exist in the County of Durham." Do you agree with that ?—Yes.

16764. You think that is so ?—Yes.

16765. Then so far as you know there is no system in the County of Durham for the periodical removal of this dust ?—No.

16766. Have you adopted such a system at your collieries now ?—Beyond the brushing, which I have told you of, we have not: We are rather waiting to hear what this Commission recommends.

16767. You say that you brush and water before a shot is fired: is that so ?—Yes.

16768. What is the object of the brushing ?—If you only water, the coal dust floats on the water and it will not mix if it is fine dust.

16769. But when you brush it do you take it out ?—Yes, we take it away altogether.

16770. And then you water what is left ?—Yes.

16771. (*Sir Lindsay Wood.*) That is only in the main wagon ways ?—Only in the main wagon ways.

16772. (*Mr. Ratcliffe Ellis.*) The accident at Wingate arose from a transgression of the rules: there is no doubt about that ?—Yes.

16773. The principal transgression, I suppose, was not so much that the shot was not fired in accordance with the rules as that the shot should not have been fired at all ?—Certainly.

16774. Have you any rule at your collieries now that before any shot is fired in the main roads the men must have the sanction of a responsible manager ?—The sanction of the manager or under-manager.

16775. If that rule was in general operation, of course with reference to those shots the amount of the explosive would be prescribed when the permission was given ?—Yes.

16776. And, as Mr. Cunynghame has pointed out, more than sufficient would not be used ?—No.

16777. Because not only would permission be given to fire the shot, but the conditions under which it should be fired would also be expressly indicated in the permission? —Yes; it would be under the supervision of the official of the mine.

16778. There is no such rule as that in existence at the present time ?—I do not think there is.

16779. But do you not think it would be an advantage to have a rule of that sort ?—Yes.

16780–1. And that is an addition which you would make to the present rules ?—I am making that addition to my own rules: I am making a special set of rules to govern that.

16782. (*Mr. Ratcliffe Ellis.*) How do you propose to enforce those rules ?—I think I can enforce them under one section of the General Rules.

16783. That is to say that the people in the mine must act under the instructions of the general manager, and if they fail to do so then they are breaking the existing rules ? —Yes.

16784. Are these rules an elaboration of the existing rules or are they more explanatory ?—They are both.

16785. But are they in effect the same—because I understood you to say that in your view the present General and Special Rules if carried out are sufficient ?—Yes, with this exception.

16786. You would add that to them ?—Yes.

16787. Are you making these rules in order to make clear the existing rules or to alter them altogether ?—I am making them to make the rules clearer.

16788. (*Chairman.*) I understood you to tell me they were more stringent ?—Well, they are more stringent—they are tightly drawn up, if I may use the term.

16789. (*Mr. Ratcliffe Ellis.*) Perhaps we may defer dealing further with that question for the present. With reference to the accumulation of dust, in addition to its removal, which you have already dealt with, would you suggest any means for preventing its accumulation ?—I have not thought that out very carefully. It is rather a difficulty with me.

16790. What are your difficulties ?—The difficulties are as to the means to adopt to prevent it.

16791. It has been suggested that a considerable amount of dust goes down the pit ?—Yes, with certain conditions of wind and so on.

16792. Do you think it would be desirable to prevent that ?—I think that some means might be taken by way of a fan probably.

16793. You think that something could be done to prevent that ?—I think so, possibly.

16794. Have you anything to suggest with regard to the construction of the tubs ?—I do not think so. We use iron tubs, and they are fairly dustproof.

16795. So that you do not think anything can be done beyond preventing the dust going down the pit, and that is a matter which you have not fully thought out ?—That is so.

16796. You say you have your shot-firers in the office every three months ?—Yes.

16797. What do you say to them when you get them there ?—The under-manager reads the rules, and asks them whether they understand them. He goes through each rule *seriatim*.

Digitized by Google

Mr. William Armstrong.

17 April 1907

16798. That is not merely done with the new men ?—No, with all the officials ; they are asked whether they understand the rules, and they are cross-questioned upon them.

16799. That is done every three months ?—Every three months or thereabouts.

16800. Is it done by the under-manager ?—Yes—by my instructions.

16801. He is a man who understands his duties, I suppose ?—Yes.

16802. You are satisfied that there is no gas at all at the Wingate Colliery ?—There is none in the Low Main seam.

16803. That is where the explosion took place ?—Yes.

16804. And you are satisfied that it was purely a coal dust explosion ?—Purely a coal dust explosion.

16805. I gather from what you have said that you are not in favour of any compulsory system of universal watering ?—No, I think not.

16806. But do you think it desirable that there should be a general system of protected zones in different parts of the pit ?—I think that is all that is admissible.

16807. And do you think that is desirable as a safeguard against the extension of an explosion if an explosion took place ?—I think in very dusty mines it should be so.

16808. Have you any definition in your mind of a dusty mine ?—No ; it is very difficult to define it, but I should put it in this way ; in all mines that are so-called " dry and dusty "—that is the meaning under the Act.

16809. Whatever the Act means you would adopt that ?—Yes, in all dry and dusty mines.

16810. You think that in all dry and dusty mines there should be protected zones ?—Yes, I think that is the only way out of it.

16811. Whether those zones should be protected by cleaning away the dust or by watering you would leave to the management ?—I think cleaning should be sufficient. But I should certainly leave it to the management. I think a great deal might be removed by a system of vacuum cleaning.

16812. If the manager chose watering so that he watered sufficiently, do you think that would be enough ?—I think that would be enough.

16813. If it was a case in which he could not water or in which he chose not to water, then he must adopt some means to keep it clear of dust ?—I think so.

16814. Is there any standard as to the quantity of dust that might remain and be harmless ?—No.

16815. That is a matter upon which you think information is required ?—Yes, it is most desirable to have information on that point.

16816. And that is a matter as to which there should be experiments made for the purpose of finding out ?—Yes ; and not only that, but with regard to coal dust and its behaviour entirely.

16817. In your view could you clear an ordinary road from dust—not a road specially constructed—so as to render what is left not dangerous ?—Yes, I think I could.

16818. Are you speaking from knowledge obtained by means of experiments ?—No, from what I believe.

16819. Then you do not think it necessary that, where the zone is to be protected sufficiently by clearing it from dust, there should be a specially constructed and cleared archway ?—No ; I only suggest that it should be protected by clearing it and watering.

16820. That again is a matter for experiment ?—Certainly.

16821. And the question of the distance and length of these zones is a matter for experiment ?—Yes.

16822. In your case the explosion went along over 200 yards of a damp road ?—Yes ; it might go through 200 yards of a wet archway.

16823. With regard to all these matters, as to distance and so on, it is very desirable to ascertain them by experiment ?—Yes, it must be so.

16824. And in your view the information so obtained would be very valuable in the interests of safety ?—Certainly, most valuable.

16825. Have you considered at all whether, in case you could not have the protected zone by watering, or in case you could not sufficiently clear it of dust without some masonry which would not stand up, there could be any additional regulations made with reference to shot-firing which might prevent danger in those exceptional cases ?—No, I do not think so.

16826. Do you consider that there should be an exclusion of any explosive ?—I do not think so. No harm has ever come from the use of any explosive except under conditions.

16827. Have you had any experience with reference to rescue apparatus ?—No.

16828. You have not seen such apparatus at all ?—No.

16829. And you cannot give any opinion as to their utility in case of accident ?—No.

16830. (*Chairman.*) There is a question which I should like to ask you as to these three-monthly lectures which you give to the firemen, as I understand, and to everybody who has anything to do with the shot-firing ?—Yes.

16831. You only give those lectures and ask those questions in connection with shot-firing ?—Yes.

16832. And not with regard to any other points of danger such as the inflammability of coal dust by itself, or anything of that sort ?—Yes, that is always mentioned. The whole of the circumstances are brought before them.

16833. They are told about the inflammability of coal dust ; therefore, with regard to what appears in this Report, that the men do not realise that the coal dust of itself is inflammable, their ignorance is notwithstanding the fact that you endeavour to enlighten them every three months ?—That Report alludes to the body of miners generally.

16834. Not to the firemen and the other people who are concerned in firing the shots ?—No.

16835. But as regards the firemen, do you think you have been able to instil into their minds that coal dust is inflammable of itself ? Because it does not seem to have occurred to this poor man who was killed in the explosion that coal dust by itself was inflammable, or he would hardly have done what he did ?—No, he would not. But the reason, I take it, is that the Low Main seam has always been immune from gas and has always been considered a wet mine.

16836. So that he considered that any precautions were quite unnecessary ?—Yes.

16837. (*Mr. Ratcliffe Ellis.*) What are these caution-boards which are shown on the Plan ; what is there on the caution-boards ?—" No naked light to be used beyond this point " ; that is just the ordinary caution-board in the colliery.

16838. (*Mr. Smillie.*) Were there naked lights used on this main intake beyond the point at which this shot was fired ?—There was only one naked light.

16839. But your first caution-board is inside the point at which this is marked. There is a caution-board therefore in the intake ? (*Indicating on Plan.*)—That is right, because that is a district by itself.

16840. And naked lights are allowed outside that ?—Yes, outside that.

16841. So that naked lights were allowed on all your intake from the pit bottom beyond the point at which this shot was fired ?—Yes, right through.

16842. (*Chairman.*) Do I understand that the shot was fired at a place where naked lights might be used ?—Yes —and were used.

16843-51. (*Mr. Smillie.*) I think you indicated that there must have been very considerable violence in this explosion ?—Yes.

16852. The stone in which this shot was fired had been there for 25 or 30 years ?—Yes.

16853. You say there was no inconvenience at all from that stone ?—No.

16854. Is this a travelling road as well as a main haulage road ?—Yes.

16855. Could you tell us how far this stone was over-hanging. It is shown on the sketch as over-hanging ?—It was something like that.

16856. There were only 18 ins. blown off it by this shot ?—Yes.

16857. So that it must have been over-hanging at least 18 ins. ?—Yes, very likely.

16858. If that was on a travelling way would it not be very inconvenient for persons travelling along it, knocking their heads against it ?—No, they knew it was there; and they never did knock their heads against it.

Digitized by Google

16859. Are you sure of that?—Yes, certain of it.

16860. In any case, Maddison had not been instructed to blow this down?—No.

16861. You have told Mr. Ellis that your monthly lectures impress upon your firemen and officials the dangerous nature of shot-firing under certain conditions, and also impress upon them that coal dust is dangerous by itself?—Yes.

16862. But I understood that you did not think that yourself until after the Wingate explosion?—I did not.

16863. Then it must have been since that time that you have given those lectures?—Yes—not all lectures, but upon coal dust, certainly.

16864. And since that time you have impressed upon them what you yourself have discovered, namely, that coal dust is important?—Yes, that is my meaning.

16865. With regard to this main intake from the pit bottom to the point of explosion, was the roof level all the way in, or was it kept up by crowns?—There was very little timbering indeed.

16866. You have very few falls on it?—Very few indeed.

16867. It is a good roof, I believe?—Yes, very good.

16868. So that there could be no cavities in which there may have been gas?—No.

16869. I find, that the last statement in the Report on page 33 expresses the regret of the three gentlemen who made the Report that the Jury made no specific recommendations as to precautions necessary in the future. What precautions do they mean?—I do not know.

16870. You do not understand what they mean by that?—No.

16871. They express their regret that the Jury did not see their way to give an opinion as to what precautions were necessary in the future—that is at this colliery, I take it?—I take it so—or generally.

16872. So that they must have thought there was something necessary?—Yes.

16873. (*Mr. Ratcliffe Ellis.*) There is a reference to the verdict of the Jury at page 11 in Mr. Ruegg's Report?—Yes: "When it is remembered that this Jury contained a large element of men with practical experience of mining, this omission in the verdict is very significant of the attitude still held by miners with regard to coal dust explosions."

16874. (*Mr. Smillie.*) You have dealt with everything but one point, I think. Mr. Enoch Edwards was very anxious to have your opinion more fully expressed on the very remarkable statement you have made that, although it has not been proved, your own theory at the present time is that the larger the quantity of coal dust there is in a pit when an explosion takes place, the less violence there may be expected?—Yes, I think so, and to the less extent.

16875. That is because of the want of sufficient oxygen to feed it?—Yes.

16876. Then you said in answer to him that there is better ventilation than there was in the old days?—Yes.

16877. Which would mean, of course, that there is more oxygen now to feed an explosion than there was in the old days?—Yes.

16878. So that if an explosion took place such as occurred at the Oaks and at Blantyre and others, which I believe now to have been largely coal dust explosions, there having been large quantities of coal dust there—three or four inches lying all along the main haulage roads—those quantities did not prevent violent explosions?—I say that was because there was a large quantity of gas present which, perhaps, did more than the coal dust itself: at all events, there was a large quantity of gas in the Oaks explosion: it was full of gas.

16879. But it does not matter how much gas there was present: you could not have more than a certain amount of oxygen there?—No.

16880. So that the presence of gas itself would not give you more oxidisation by the air?—No, but the explosive gas and air would explode, to begin with. Whatever oxygen was in the ventilation would go to set up the coal dust explosion, but the violence of the gas explosion would be terrific.

16881. It has not been scientifically proved yet as to whether a large quantity of coal dust would be more explosive than a small quantity?—No: that is why I say it should be tried by experiment.

16882. I think you will agree that experiments should be conducted to find out whether that is so?—Undoubtedly it is only a theory.

Mr. CHARLES SPEARMAN CARNES, called and examined.

STATEMENT OF WITNESS:—

16883. In dealing with the questions put before me which I quote:—

(1) *How far is it possible to prevent the accumulation of inflammable dust?*

(A) *By rendering the wagons dust tight.* I do not think it is practicable to improve the present make of wagon or tub, although at Murton, to prevent the fine coal getting through the joints, the tub was built with tongued and grooved boards; but in many instances the joints become filled or choked, and if the tubs are kept in good repair, there is a very small proportion of fine coal wasted in this way.

(B) *By covering wagons or spraying.* It would not be practicable in the County of Durham to cover the tubs with either a lifting lid or hinge lid as the height of the seams would absolutely prevent this. Spraying on the top of the tub before coming into the main haulage road is adopted at some few collieries with good results, but there is the difficulty of obtaining water, and also to be of real service a considerable quantity of water should be put on the top of each tub. In many cases I do not think it would be possible to adopt this method and, in addition, it would be detrimental to the coal for some purposes.

(C) *By removing screens or collecting dust from screens by a fan.* There is no doubt that considerable quantities of dust go down the down-cast shaft from the screens, but I do not think it is necessary to remove the screens, as a large quantity of the dust can be collected by means of a fan or can be prevented by means of a steam playing on the top of the screen, immediately over where the coal is teemed. This was adopted at Murton with good results; but I think the most effective preventive would be to close or box in the down-cast shaft from the surface or ground level to the heap-stead level.

(2) *The principal method of dealing with inflammable dust is by watering* (A) *complete* (B) *partial.*

(A) *Do you advocate complete watering of the roadways, and, if so, what system do you recommend?*

If the strata will allow it, I recommend complete watering by means of having water-pipes the full length of the main haulage road with fixed hydrants at certain intervals to which can be attached hose pipes, these to be manipulated by workmen. In a very dry and dusty mine, sprays fixed on the same pipes would be an advantage. I have not known or had experience with compressed air for removing dust. To be complete the roof and sides, as well as the floor, should be watered. How often this should be repeated will depend upon the amount of dust on the particular haulage road, but I have found that once a week is sufficient. In regard to the system of watering in force in Germany, I do not think it is necessary to go to the same extent in the County of Durham, as in the working places (or face) and returns there is very little dust to be found; but it would be necessary to water self-acting inclines the same as main haulage roads. I do not think it advisable to water the coal as it is got down, as the value of certain classes of coal depends upon its freedom from moisture.

(B) *Would partial watering and the fixing of zones be sufficient to prevent the extension of coal dust explosions?*

The provision of zones kept entirely free from dust would, I think, prevent the extension of coal dust explosions. If water is obtainable, partial or complete watering of these zones would be effective; but if this

Digitized by Google

Mr. C. S. Carnes.

17 April 1907

is not so, I would recommend that for a distance of 100 yards it be either arched with masonry or the surface of the sides and roof be made smooth, and the floor paved and these be thoroughly brushed, and I think in this case the use of salt would be advantageous, as it would tend to render any remaining dust on the ground non-inflammable. I should recommend the placing of such a zone at the entrance of each main haulage road or district.

(3) *Cost of watering.*

In calculating the capital outlay, I take Messrs. Bolckow, Vaughan & Company's Collieries which have in all 55 miles of main haulage roads, and to put in 2-inch water-pipes, with the necessary hydrants at intervals of 80 yards, with hose-piping and other connections, including labour, will amount to £300 per mile, which would represent a total of £16,500 to put in a system for the complete watering of the main haulage roads of these collieries. The cost of maintenance with a good roof would not be material, and from experience I have found that one man can keep efficiently watered a mile of haulage road the cost of which would be £78 per mile per annum, or a total for these collieries of £4,290 per year. The distance that a man can keep completely watered depends, as I have said before, on the amount of dust which is produced on each haulage road.

(4) *Objections to watering.*

There are in some instances, serious objections to watering, as it causes movement of the strata, and consequently falls of roof occur, and the bottom, or floor, heaves, which in turn breaks the supporting timbers and increases danger; but the conditions of the collieries in the County of Durham are such that watering would not be, I consider, a danger to health.

(5) *Do you think any other system than watering would be effective?*

I think watering the most effective, but where it is not prudent, or safe, to do this, I have had the main haulage roads brushed with very good effect, and where the strata will not allow watering, if zones at the entrance of each main haulage road, or district, were adopted, and either arched in masonry, or the sides and roof made perfectly smooth, these zones, I consider, can be kept perfectly free from dust.

(6) *The use of salt.*

In mines that are not very dry, and which are not more than 900 ft. deep, I have tried salt, which has a dampening and beneficial effect, and if, where it is not safe to use water, salt was put down in the zones mentioned above, it would, I think, assist materially.

(7) *Shot-firing.*

With the present methods of working in the County of Durham, viz., with two and three shifts of hewers, it would not be possible to prohibit shot-firing during shifts, but I think it would tend to lessen accidents if there was a rule that no individual man be allowed to carry both the explosive and the means of firing it; and where shot-firing has to be carried out on the main haulage road a competent person should be authorised by the certificated manager, the authorisation to be only from day to day, and before any shots are fired the place should be examined by a superior official. But I am of opinion that if the workmen and those who are authorised to fire shots would strictly observe and carry out the existing rules the risk of an explosion would be very greatly minimised.

16883A. (*Chairman.*) You are a Mining and Mechanical Engineer, Mining Agent for Messrs. Bolckow, Vaughan and Company, Limited, Member of the North of England Institute of Mining and Mechanical Engineers, and of the Institution of Mining Engineers?—Yes.

16884. You have had experience not only in Messrs. Bolckow, Vaughan and Company's group of 13 collieries, but you were for eight years certificated manager at Murton Colliery, near Sunderland, and before that you were for four years certificated manager at Hutton Henry Colliery, and for four years certificated manager at three of Messrs. Pease & Partner's Collieries?—Yes.

16885. Therefore you have had very considerable experience of mining in the North of England?—In the County of Durham.

16886. Are all those collieries in the County of Durham?—Yes.

16887. As regards precautions against dust and clearing away dust, you say that the wagons which are in use in some of the collieries which *you* are acquainted with are built with tongued and grooved boards, and that if they are kept in good repair there is very little fine coal wasted?—That is what I have found.

16888. So that you think there is not much to be done, at all events in your district, with regard to improving the type of wagons?—That is so, if they are kept in repair.

16889. Do you think they are kept in good repair?—Mostly.

16890. But you would suggest perhaps that a little more care might be taken to keep them in repair than is taken at present?—In cases it is advisable, I think.

16891. You say that you have sometimes known cases of wagons which have not been kept in repair, and that in consequence there has been a good deal of extra dust found in the roadway?—That is so.

16892. I do not know whether there is any Special Rule in existence in Durham with regard to the repair of wagons, any rule as to looking over them at any stated periods to see whether they want repairing?—There is none to my knowledge.

16893. There is no rule of that kind?—No.

16894. Do you suggest that there ought to be any set of rules drawn up which would regulate, say, the inspection of wagons?—I do not think that would be necessary.

16895. Still, at the same time you say that these wagons are not always kept in repair?—That is so. In a well-managed colliery it should not be necessary to have such a rule.

16896. No, but I suppose the Legislature does not so much regulate matters for well-managed collieries as for collieries which are not well-managed, and if it is important, as it appears to be, that wagons should be kept in a good state of repair, possibly it might be advisable to have some Special Rules laid down, or even some General Rule made in an Act of Parliament with regard to the repair of wagons. That is the suggestion which I make; but you say that on the whole you do not think that would be necessary?—It is very desirable to have the tubs kept in thorough repair, there is no doubt; but as to whether it would be necessary to have legislation on the matter I should not like to say.

16897. I do not think anybody has suggested in evidence before us that wagons should be covered, but many witnesses have said that they do not think it would be practicable to cover the tubs?—I do not see how it could be carried out where there are thin seams.

16898. Do you think it could be carried out in any mine; do you think it would be desirable that wagons should be covered anywhere?—I do not think so, because where you have the higher seams the tubs are very often loaded above the top.

16899. So that it would lead to a great deal of expense and inconvenience if they were covered?—That is my opinion.

16900. In your part of the world you do not suggest spraying. Spraying is carried on in many parts of England, but you say that in Durham the coal is of such a quality that you could not very well spray it, or rather, that it would damage the coal?—That would be so at some of the collieries with regard to different kinds of coal.

16901. Would it be desirable to spray any of the coal in Durham?—It is done in some collieries, and I believe with good effect; but, of course, there is the difficulty of getting the water to the right place to spray them, and then in gas coal and some kinds of coals which are coking coals, I do not think it is desirable to wet them.

16902. Do you think enough spraying is carried on in Durham, or that the system of spraying might with advantage be made more universal than it is at present?—I do not think it is desirable.

16903. You think that where the coal is of such a quality that it would not deteriorate by being sprayed, and it is reasonably practicable to spray the wagons, they are sprayed, and that in fact as much spraying is carried on as is desirable?—No, I do not think that.

16904. Then you think more spraying might be carried on with advantage?—I do not think so: my experience is that the coal which gives off the most dust on top of the tubs would be the coal that you should not spray.

16905. That is to say, that spraying would deteriorate the coal?—Exactly.

16906. So that where the coal can be sprayed you think it is of very little use to do so?—Yes.

Digitized by Google

16907 Where the coal is of such a quality that it can be sprayed without damage you think it is very little use to spray it ?—Yes.

16908. But at the same time, that is done ?—It is done in some collieries.

16909. You do not think that the system of spraying should be increased and that more spraying should be done than is done now ?—I should not advise that more spraying should be adopted.

16910. You suggest that it would be a good thing to collect the dust from the screens by means of fans and to prevent it going down the shaft ?—That is one way of collecting it.

16911. Or by means of a steam jet ?—I have used a steam jet with very good effect.

16912. You suggest that one or other precaution should be adopted where the screens are near the pit mouth ?—I do.

16913. Either steam jets or else some system by means of a fan of preventing the dust going down the pit ?—Or to box or build the entrances of the downcast pit so that the dust could not get down.

16914. You think something should be done to prevent the dust going down ?—My experience is that large quantities of dust go down the main downcast shaft.

16915. And that ought to be prevented as far as possible ?—Yes.

16916. You suggest that the most effective way is to box in the downcast shaft from the surface or ground level to the heap-stead level ?—Yes.

16917. That is one way of doing it ?—Yes.

16918. And the two other ways are by means of a steam jet or by means of a fan ?—Yes.

16919. With regard to watering you say that if the strata will allow it you would recommend complete watering by means of having water-pipes the full length of the main haulage road: so that you consider that where no damage is likely to result to the mine and no further danger owing to falls of roof and sides, it is a good thing to have mines completely watered ?—It is decidedly the most effective way.

16920. It is the most effective way in order to prevent the accumulation of coal dust ?—Yes.

16921. Would you make it compulsory that mines should be completely watered where the circumstances are such that there would be no increase of danger, or very little increase of danger, from falls of roof and sides, and no very great expense owing to heaving of the floor, or other causes ?—The main haulage roads.

16922. The main haulage roads should be kept completely watered ?—Where it can be done.

16923. Where it can reasonably be done ?—Yes.

16924. And you think that might be made obligatory on mine-owners and mine managers ?—In dusty mines.

16925. That in the case of a dry and dusty mine, where complete watering could be carried out without causing any prohibitive expense, and without causing any increase of danger owing to falls of roof and sides, it should be done ?—I am of that opinion.

16926. You say that the best way of doing it is to have water-pipes the full length of the main haulage road with fixed hydrants at certain intervals, to which can be attached hose pipes, these to be manipulated by workmen. Then you say that in very dry and dusty mines sprays fixed on the same pipes would be an advantage. There would be more complete watering by means of sprays in proportion to the amount of water used ?—What I have had done is this: workmen have hosepipes and thoroughly wash both the roof and the sides. In regard to the question of sprays, they would only become effective in laying dust as it is blown from the tubs as they come out of the shaft: they would lay any dust that is blown off in that way—that is to say in a very dusty mine.

16927. Then you would not use them for any purpose except spraying the wagons—I mean not for spraying the roof and the sides ?—If you have a workman using the hose—a hogger—then the spray for the roof and sides is not necessary: but in some cases there are fixed sprays with a small spray of water always coming, and that moistens the air, of course, and takes up any dust that may be blown from the passing tubs.

16928. In the evidence which you gave at the Inquest on the Wingate Explosion you said that what you do is to brush the dust off the timber which falls into the roads, and then water the roads. So that in many places where I suppose it would be difficult, or possibly dangerous, to water the roof and sides, you content yourself with watering the floor ?—In the particular seam which was in my mind at that time it was dangerous to water the roof and sides, but it was not dangerous to water the floor.

16929. And you consider that if you brush the roof and sides and water the floor, that is sufficient to ensure safety ?—I would not say that: it will minimise the risk. In brushing I do not think it is possible to deal with the whole of the dust to the same extent as you can deal with it by watering.

16930. Not even if you had brick arches ?—If you had brick arches you could brush them better.

16931. You would not like to say that the brushing of an ordinary road which is not brick-arched, and which has timbers across it could be carried out so effectively as to diminish the amount of coal dust so much that there would be no risk of explosion ?—My experience is that you still leave a certain amount of dust after brushing.

16932. What amount—enough to carry on an explosion or to initiate an explosion ?—I would not say that it would initiate an explosion, but it might carry it forward.

16933. Do you agree with the last witness in thinking that it may possibly be the case that the thicker the dust is the safer the mine is, and that a very large amount of dust may, as it were, smother an explosion ?—I am afraid I am not at one with Mr. Armstrong upon that.

16934. You do not agree with him ?—I do not agree with him upon that.

16935. You think that probably the more dust there is, the more the explosion would be carried on ?—That would be my opinion.

16936. (*Mr. Ratcliffe Ellis.*) That is, gas or no gas ?—Gas or no gas.

16937. (*Chairman.*) Then you acknowledge that in order for it to be completely watered, you must water the roof and sides as well as the floor; and that would depend upon the nature of the roof and sides, because if the roof and sides are very much damaged by water, that would create another danger ?—Certainly.

16938. Besides being expensive ?—Yes.

16939. You found that once a week was sufficiently often to do the dusting on the haulage roads ?—For the watering.

16940. That is to say, the watering must take place once a week ?—Yes, that is sufficient, as I have found.

16941. At the end of the week you found it fairly damp ?—Reasonably damp, but, still, it is better to be watered again.

16942. You say that, in regard to the system of watering which is followed in Germany, you do not think it is necessary to go to the same extent in Durham, as in the working places and returns there is very little dust to be found; but it would be necessary to water self-acting inclines the same as main haulage roads ?—Yes.

16943. With regard to zones, you recommend a zone of 100 yards either arched with masonry or the surface of the sides and roof made smooth, so as to plaster it down and have some sort of cemented surface ?—To have it as smooth as possible.

16944. And also to have the floor paved. I suppose you could not always pave a floor, could you ?—No.

16945. It would heave ?—It would heave.

16946. You think that in this case the use of salt would be advantageous, as it would tend to render any remaining dust on the ground non-inflammable ?—Yes.

16947. Have you made experiments with regard to salt ? We have had differences of opinion expressed as regards the use of salt for this purpose; some people think it is no use at all ?—I speak rather from the experience which I have had with it. It is effective unless you take a very dry mine. I should say I have in my mind mines up to 900 ft. deep, and it is effective in those cases.

16948. If a mine is very dry and the atmosphere is very dry, the salt has no effect, or hardly any, because it cannot get sufficient moisture out of the air to mop up the dust ?—That is what I should say; but what I have tried is in mines not more than 900 ft. deep, and 24 hours after putting salt on dust you can take the dust in your hand and it will adhere the same as clay would.

16949. You have found that to be so, even in fairly dry mines ?—Up to 900 ft. deep.

Digitized by Google

Mr. C S. Carnes.

17 April 1907

16950. And you do that to a considerable extent ?—We do not do it to a very large extent. I am doing it principally in the neighbourhood of electric haulage engines—in-bye engines.

16951. Why do you do it there in particular ?—Just to keep the dust absolutely down.

16952. Where it is very necessary that the dust should be kept absolutely down you do it with salt for short distances ?—Yes.

16953. Coming to the objections to watering, you say you think that the conditions of the collieries in the County of Durham are such that watering would not be a danger to health. In what way do you consider that in other collieries watering might be a danger to health ?—Do you mean other than in the County of Durham ?

16954. Anywhere. You say that in the County of Durham it is not dangerous to health ?—I say that is so in my opinion. Of course it has not been actually tried, and there is the fear that if you have complete watering throughout the whole of the mines, there is a danger of having the disease which they have in Germany, ankylostomiasis ; but that is only an opinion.

16955. You have not gone into the question, I suppose ?—No.

16956. But as regards the mines in Durham, the amount of damp that would be produced by as complete a system of watering as you could have consistent with the kind of strata, would be rather an advantage to health than otherwise, you say ?—I do not think it would do any harm to health, I am of that opinion. Of course it has not been proved by any experiment or by actual use. Where we have had complete watering in main haulage roads, there has not been any harm to health.

16957. Therefore, you do not know of any cases in which complete watering has caused a mine to be so damp as to be injurious to the health of miners ?—I do not know of one.

16958. You say that where watering is not prudent or safe, you have had the main haulage roads brushed with very good effect. Is that the system which you describe in your evidence—that you brush the dust off the timbers and it falls on to the road, and then you water the road ; or do you sometimes brush the floor as well ?—We did not brush the floor ; we brushed the roof and sides and then gathered up the dust.

16959. You damped the floor ?—We damped it in some cases and then gathered the dust together and raked it up.

16960. Do you mean dry ?—Yes.

16961. Sometimes you rake it up quite dry ?—Yes.

16962. But do you not find that the current of air carries the dust into other parts of the mine ?—Of course it does to some extent. But where it is dangerous to water the floor, or where it is not right that you should water the floor, you have to do that.

16963. That is the only way in which you can clear the dust ?—Exactly.

16964. But it is naturally a disadvantage to be obliged to collect it dry ?—No doubt.

16965.—With regard to shot-firing, you say it would be impossible where you have two or three shifts of hewers to prohibit shot-firing during shifts. Is that so ? We have had some evidence on that point, and I think it has been acknowledged that where there is very little shot-firing you might arrange occasionally, say, once a week, for shot-firing to take place in the absence of men between shifts, and that you might arrange even where mines are working on two or three shifts for there to be on one day in the week some sort of interval for shot-firing during which you would have very few people down the mine ?—Do you refer to shot-firing in the coal or in stone ?

16966. I think in both ?—Because in the County of Durham on each shift that the hewers go to work usually there are shots fired.

16967. If you have two or three shifts I understand that, unless it is a very exceptional thing to have shot-firing, you could not very well arrange that all the men should be out of the mine and that shot-firing should only take place between shifts ; but I suppose you might have cases of exceptional shot-firing in the coal, just as you would have it elsewhere ?—No, I should say not.

16968. That it would not be an ordinary thing where you are firing shots to get the coal down, but there might be cases in which it would be desirable ?—Where it is necessary to fire shots in the coal it is done constantly.

16969. If that is so I can understand that you could not very well arrange, with two or three shifts, that the men should be away when you fired the shots ?—It would be very rare that you had occasional shots in the coal ; that is not usual.

16970. You would either have a lot of shots in the coal, or none at all ?—Exactly.

16971. But as regards shots fired in the stone, I suppose every now and then in a mine where there is very little shot-firing you have to have a shot fired in the stone ?—Where we have thin seams, similar to what we have very largely in the County of Durham, you have shot-firing in the coal daily.

16972. Constantly ?—Well, I do not mean during the day when the coal hewers are in, but when the men are making height in the stone they are firing shots, and even in that case you could not prohibit shot-firing during the shift. For making height it would not be practicable to prohibit shot-firing when the stone-men are in the pit.

16973. (*Mr. Smillie.*) They are usually in the face ?—Yes—ripping.

16974. (*Chairman.*) So that you say there would be very few mines in which, where you had two or three shifts going, it would be reasonably possible to arrange that shot-firing should only take place between shifts ?—There are none to my knowledge.

16975. There are none in Durham to your knowledge ?—No.

16976. But it is possible on your own engine roads ?—Yes, but that is another matter.

16977. Then on engine roads you would not fire shots except when the men are out of the mine, do I understand ?—I would not go to that extent. I say that if it is dangerous to that extent—that you have to have all the men out of the pit—the shot should not be fired at all.

16978. But still at the same time there is a General Rule which says that under certain circumstances shots can be fired, but they can only be fired when the men are out of the pit ?—That is so ; and my opinion is that if a mine is dangerous to that extent, that you would only have two or three men in the pit when you are firing the shot, that shot should not be fired.

16979. Then you think that the General Rule ought to be amended, and that there should be no such thing as permission given to fire a shot which is considered to be so dangerous that as few men as possible should be down the pit ?—I think it should be taken into consideration that if you have two or three men down the pit their lives are of value.

16980. I suppose that sometimes it might be almost necessary for the working of a mine that a particular shot should be fired in an engine plane ?—No. I would not say that. It might be very costly to remove the stone.

16981. But still it could be done ?—It could be done without firing a shot.

16982. And you think it ought to be done, however costly ?—During the eight years that I was at Murton there was not a single shot fired, and we were drawing up to 4,000 tons a day. There it was necessary that stone should be removed, and we had to take other means than firing shots.

16983. You could have done it much more cheaply by using explosives ?—Yes, much more cheaply.

16984. You thought it was so dangerous that you would not do it ?—Yes.

16985. (*Mr. Cunynghame.*) I should like to ask you some questions with regard to the cost of apparatus for watering. I do not wish to put it on to any particular mine, but I should like to get some general figures. The way in which one would like to get it is something of this kind : to arrive at the capital expenditure necessary to put the apparatus down completely, then take, we will say, 15 per cent. of that as a yearly sum necessary for repairs and interest on capital—we will assume 15 per cent. if you like, or any other figure you think proper—and put that down as the yearly cost ; then one would like to add to that the cost of the labour of watering, and then to add to that any further sum that may be necessary for repairs to roof and sides caused by the watering. I think, putting it from that point of view—we will go into the details deliberately in a moment—that would represent a picture of the cost of the working of a particular mine, would it not ?—Yes, I should say so.

16986. Now I should like to have those items one after

Digitized by Google

the other. Take a mine which contains 55 miles of main haulage roads. To put in 2-in. water pipes with the necessary hydrants at intervals of 80 yards with hose piping and connections, including labour, you estimate would amount to about £300 per mile?—That is at the present price of material.

16987. At present prices; that represents £16,500 capital, does it not?—Yes.

16988. That at 15 per cent. amounts to about £2,500 a year, in round figures, apparently?—I have not checked it, but I suppose that would be right.

16989. It is something like that, I think—roughly speaking: we only want rough figures?—Yes, that is right.

16990. Then, next, the cost of the labour of watering would be £4,290 per annum, I think, according to your figure?—Yes; that is in the next paragraph of my statement.

16991. That you put at £78 per mile?—£78 per mile per annum.

16992. How do you get at that figure of £78?—I have taken the wages of the men who are doing it. The man I have had doing it is paid 3s. 5d. plus a percentage: I have taken it at 5s. per day for wages.

16993. 5s. per day is an all-round figure?—Yes.

16994. How many men?—One man will keep a mile sufficiently damp.

16995. So that you have 55 men at 5s. per day, in round figures?—Yes.

16996. That is how you make up your £4,290 per annum?—Yes.

16997. Does that include everything that is necessary?—Yes.

16998. That does not include trolleys or trucks to carry the water about and squirt it on to the ceiling?—We have none of those.

16999. You consider that your plan of having hydrants and playing the water on is as much as you dare do?—We have a 2-in. water pipe the full length of the main haulage roads, and a hydrant every 40 yards. The 2-in. pipe is the full length of the haulage road.

17000. The indiarubber connection, I suppose, is about 40 yards long?—It is about 30 to 40 yards long.

17001. With that you can get over the whole ground?—Yes.

17002. You have no truck system of carrying that water about at all, according to your method?—No.

17003. You simply water the roof and sides as much as is thought prudent, and let a good deal flood the floor?—Yes.

17004. There is no objection to flooding the floor pretty considerably?—Not where the strata will allow of it.

17005. But in that particular mine you can flood a goodish bit?—Yes.

17006. With the roof and sides do you have to be more careful, or is it possible to give them a thorough good drenching. in that mine at all events?—In that mine we were able to give them a thorough good drenching, to wash all the dust off both from the roof and sides and to allow the water to run on to the bottom.

17007. Then in this mine it would not be necessary to put down much, or anything, under the head of repairs necessary to roof and sides, would it?—Exactly.

17008. But in other mines it might be?—Yes.

17009. So that your figures in regard to this mine come to £2,500 a year for upkeep and interest on capital, and £4,290 for labour?—Yes.

17010. Supposing the roof in a mine was not as favourable as it is in your mine, and that the sides were not as favourable as in your mine, can you give us any idea as to what figure would require to be added to that amount in order to arrive at the real expense?—For a bad roof?

17011. Yes; take the case not of an excessively bad roof, but of a rather bad roof?—Yes.

17012. Can you work that out per mile?—I could not give you that figure, because in a case of that kind it would not be prudent to put the water pipes.

17013. I am taking a case in which it would be prudent, but in which a certain amount of repairing would be required?—I could not give you that information.

17014. Can you give us no sort of idea whatever?—Not to be reliable, because it would depend entirely upon the renewal of the timber to what extent there was repair.

17015. I am taking all that into consideration. You would not put it as much as another £2,000 a year, would you?—I should say more than that.

17016. Do you think it might come to £3,000 or £4,000 or £5,000 more?—Yes, I should say so.

17017. (*Mr. Ratcliffe Ellis.*) Would there not also be a loss owing to obstruction of the work if those roads were constantly wanting repair; there would be not only the cost of the repair of the roads, but interference with the general working of the mine?—Exactly.

17018. (*Mr. Cunynghame.*) There might have to be something allowed for that also?—Yes.

17019. I want to get a fair picture of the whole amount of expenditure necessary?—It would be fully what you say, I should think.

17020. It might come to that, but at all events on that head you are not prepared to give us any particular figure?—I am not.

17021. What is the quantity of annual output that we are to take as the tonnage got out from this mine? I want to know how much your figures will amount to per ton?—What I was speaking of was a mine being thoroughly watered.

17022. Yes, thoroughly watered according to your system of watering, which is a system of watering throughout, and which costs close on £7,000 a year, without counting repairs to roof, which are not necessary, or not specially necessary, in your case. What are we to take as the tonnage output per annum?

(*Sir Lindsay Wood.*) That is, over that 55 miles?

(*Mr. Cunynghame.*) That is, over the whole 55 miles.

(*Witness.*) In the collieries which I have charge of, I say there are 55 miles of haulage roads, and I am certain that there are some of those that we cannot thoroughly water. Over those 55 miles of main haulage roads last year we had 2,736,000 tons passing.

17023. Those 55 miles of haulage roads represent several collieries, do they?—Thirteen collieries.

17024. What is the output of the whole 13 collieries?—Last year it was 2,736,000 tons.

17025. Then how much does your £7,000 a year represent per ton? That is what I should like to have figured out if you could do it. It is not very difficult to do?—But although that quantity of coal came over those main haulage roads, there are some of those main haulage roads that you cannot water.

17026. That is true, but your 13 mines would represent pretty well an average of what one might say was not an unusual thing in a colliery. I will put it in another way: would it not be fair to say that, for an output of 2,736,000 tons, £7,000 a year was about the amount required in a mine of your description where the roof was good and the sides were good and the watering did not do much damage, that is to say, £7,000 a year spent upon the getting of 2,736,000 tons yearly?—£7,000 a year for the whole lot?

17027. Yes?—I should say you are right.

17028. I propose to put it in this way: you are getting that amount of coal and you are spending £7,000 a year on this watering?—Yes.

17029. Therefore, in mines resembling yours—and yours are under favourable conditions—it would mean £7,000 divided up among 2,700,000 tons of coal?—Yes.

17030. That comes to something over ½d. and under ¾d. per ton?—0·61d.

17031. That could not be considered, I should say, at all a heavy burthen in consideration of obtaining safety, supposing it gave you safety?—Well, we look at all the halfpennies to be added to the cost.

17032. One quite agrees, and the public probably desire that you should look to the halfpennies carefully; probably they do not desire you to have profits in which the halfpennies are not worth consideration, but at all events, that ½d. could not be considered a very heavy outlay for the purpose?—No, it is not a very heavy outlay.

17033. That is for securing the result of safety?—Yes.

17034. We will call it ¾d., as I daresay it would come to very nearly that by the time it was done with; that ¾d. might be increased by another ¾d. in case the roof and sides were bad?—Yes, fully.

Digitized by Google

Mr. C. S. Carnes.

17 April 1907

17035. That would make it 1½d. per ton?—Yes.

17036. I suppose it is impossible to give an average price per ton at the pit's mouth throughout the country—the proportion of that which is cost and that which is left for profit. We can get no figures of that kind, can we?—I should not think you could.

17037. I mean general figures throughout the country?—I do not think you could get such figures.

17038. I suppose we could not get from you any idea of what percentage of profit that 1½d. represents?—It largely depends upon the position of the colliery, and there are many conditions that add to that; some collieries are better placed for disposing of their outputs than others with regard to railway dues and so on.

17039. Are you aware whether any general calculations of that kind have ever been made?—Not to my knowledge.

17040. That would enable us to get an idea of what 1d. per ton expended meant in loss of profit?—There is this to be said, that in a very dry and dusty mine an expenditure of ¾d. per ton to render a colliery absolutely safe I would not consider excessive.

17041. Nor even possibly 1½d., if it was really dangerous?—No.

17042. (*Sir Lindsay Wood.*) In that colliery you made out the cost to be about ¾d. per ton?—Yes.

17043. (*Mr. Cunynghame.*) It would be ¾d. per ton by the time they had done with it?—Yes.

17044. (*Sir Lindsay Wood.*) I understood you to say that it would not be an excessive item if it produced any safety in the mine?—If it made a very dry and dusty mine perfectly safe I should not consider it a prohibitive cost.

17045. But taking your mine, in regard to these 55 miles of road you would have to pay £7,000 a year for that?—If they were all very dusty——

17046. No: if you watered all your mines in the way proposed, it would cost £7,000 a year?—Yes.

17047. That would save you how many accidents from coal dust explosions during the last year?—I do not think it would save us many.

17048-9. Would it save you any that actually did take place?—There were no explosions in these collieries last year.

17050. Therefore, you would pay £7,000 a year for not getting any greater safety than you actually have?—So far as the results are concerned.

17051. Well, that is what we want?—But if you take, for example, Wingate———

17052. No, we are not taking Wingate?—I know you are not.

17053. In your colliery alone you would expend this £7,000 a year over the period you have been there, to get no greater safety than you have already?—You would get greater safety because you would have all the dust disappear.

17054. What accident has occurred from dust in that mine?—None.

17055. Then how would you get greater safety?—Then you would have no risk of an accident from dust.

17056. But you have never had an accident?—There has never been an accident, but there never was an accident at Wingate before that one.

17057. But Wingate is another case altogether?—No, excuse my putting it in this way: at Wingate the place where the explosion occurred is in the low Main Seam, and it would be generally acknowledged in the County of Durham that it is a seam which has always been considered free from dust, and that never had an explosion up to that time.

17058. But there must have been dust there?—There was.

17059. And the shot was fired in breach of the rules?—Exactly.

17060. That was a different case altogether. Take the whole of England: how much would it cost throughout the whole of England, and how many deaths would it save, provided that all the rules had been fully carried out? How many deaths would have occurred?—I could not say that.

(*Mr. Cunynghame.*) If you did the same thing throughout the whole of England, out of 220,000,000 tons put out annually the cost would be not quite £1,000,000 a year.

17061. (*Sir Lindsay Wood.*) What I want to get at is the number of deaths that ought to have been prevented if the existing rules had been carried out, irrespective of watering entirely?—That is another matter. My opinion is the same as Mr. Armstrong's, that if the existing rules were strictly adhered to they are ample. But that, of course, is another question, which I suppose will arise later. I am firmly of opinion, as Mr. Armstrong is, that if the existing rules were strictly adhered to by officials and workmen, these accidents would not occur.

17062. That is to say, not the large accidents?—No.

17063. There has been really more precaution taken by people to prevent an accident happening through neglect?—Exactly.

17064. But if the cause of the accident was stopped, as you seem to think it could be stopped, by observing the Rules, it would not be necessary to go to this expenditure of £1,000,000?—That is my view.

17065. You say you think that dustless zones would be a means of stopping explosions. You were, I think, at the Wingate explosion?—Yes.

17066. Will you take the map and point out to me where you would have put your zones to stop that explosion?—Of course the question of zones is entirely a matter of theory. My idea is that where you cannot water it would be an advantage to have a zone.

17067. If you knew where the explosion was going to take place?—Well, if we knew where the explosion was going to take place we should not fire a shot, and we would not have an explosion, of course. I will put it in this way: if there has to be some precaution taken and regulations made, and you cannot water, and you have to brush off the dust or take some other means of doing away with the dust, you cannot take away the dust altogether by brushing, or anything of that kind, and a zone would help, in my opinion.

17068. If the explosion came through it?—Well, I think it would probably stop the explosion; it would stop it spreading.

17069. If it was in the course of the explosion?—Yes.

17070. I think the evidence which we have heard has been to the effect that you would place your zones at the junctions of the various ways?—Yes.

17071. Will you show me on that plan where you would put your zone?—I would put a zone here, and here, and here (*indicating on Plan*); *this* is, of course, in the district coming back; and also one here (*pointing*).

17072. That would have stopped the explosion coming *here*?—If you had one *here* of course it would come out to that; but again, if you had one *here* it would prevent this explosion coming in *here* or going out *there*.

17073. But you would put one close to the shaft siding. It is very difficult to state where you would put it?—Of course if you put it at the shaft siding it would probably have to be longer, and it would probably prevent the explosion going to the shaft.

17074. It might save the shaft?—It might save the shaft.

17075. And it might kill all the men around?—Yes.

17076. Really if zones are to be safe they should be placed certain distances apart along the whole length of the wagon ways?—Yes, I should say so.

17077. You said that spraying the tubs would damage certain classes of coal?—Yes.

17078. It would not damage the harder classes?—No, not to the same extent.

17079. But in those classes of coal it would not be necessary to water?—No. I said that where it would be the most use in spraying it would do the most harm.

17080. With respect to keeping the tubs in repair, I take it it would be to the advantage of owners that that should be done?—I should say so, certainly.

17081. (*Mr. Smillie.*) I think you agree that it is desirable to prevent the accumulation of dust in underground workings as far as possible?—Yes, I do.

17082. You agree, I believe, that the accumulation of dust is dangerous underground, from your past experience of it?—I do.

17083. And that it is desirable to prevent its accumulation underground?—Yes.

17084. With regard to the spraying of full trams, you say that the spraying of trams injures some classes of coal?—Yes.

Digitized by Google

17085. Does the same thing apply to the same class of coal in the trucks on the surface; does the rain deteriorate the value?—It does to a certain extent.

17086. In transit between the colliery and where the coal is to be used?—And in some cases in the County of Durham they are sheeted—they are covered over.

17087. The trucks on the surface?—Yes.

17088. For that purpose?—Yes, to prevent spontaneous combustion, I suppose, in shipping—in the steamers.

17089. Is it that deterioration that you fear?—That is one of them, so far as putting this class of coal into trucks.

17090. The members of the Commission, I think, are of opinion that the spraying which has been mentioned so frequently in the evidence is not of such a nature as would wet the coals in the tram, merely spraying the surface to keep down the dust on the surface?—Spraying, to be of any service, ought to be done fairly thoroughly, that is more than just putting a coating of water on top of the tub, because in the shaking in haulage you would soon shake that down.

17091. What percentage of the Durham coal would that apply to? It is usually of a hard nature, I think?—No.

17092. Is 50 per cent. of it of such a nature that would make spraying——?—My own opinion is that spraying would not be effective.

17093. Are you of opinion that a considerable quantity of dust is blown off the trams in transit to the pit bottom?—Most certainly a very considerable quantity is blown off.

17094. Where spraying is inadvisable is there any other method which could be taken to prevent that dust being blown off, other than the closing of the mouth of the trams?—I do not think so.

17095. I think you agree that the closing of the mouth of the trams is out of the question?—Out of the question, I consider.

17096. Your trams generally in Durham are dust-tight, where it may be blown off at all?—Yes, I should say so.

17097. They are fairly dusty. I think you are of opinion that zones, either watered zones—watered zones preferably—but either wet or dry, would tend to prevent the spread of explosions?—Yes.

17098. And that where it is possible to have wet zones, if not continuous watering in dry and dusty mines, you should have wet zones?—I think it would be a preventative. It would prevent the spreading of an explosion.

17099. You were one of the explorers in the Wingate explosion immediately after the explosion, I think?—I was.

17100. Did you traverse the stable section, the section shown in the Plan of the stables?—I was in it.

17101. I think you heard Mr. Armstrong stating that the explosion traversed a considerable portion of the stable section. On the Plan it is shown to have gone off at an acute angle through the stable section?—Yes, I did.

17102. At a very acute angle, I think?—It is at the back, I think. I have it here. It came in here to that point (*indicating on Plan*).

17103. Do you agree that this part from that first air crossing, where it has evidently turned off, was dry and dusty, into that other air crossing stable way?—Of course Mr. Armstrong ought to be able to speak more accurately than I can, but I am of opinion that there was dust there. It was undoubtedly wet on the bottom.

17104. It was wet on the bottom?—Yes.

17105. Are you of opinion that there was accumulated dust on the timbers and sides?—Not in the return, to any extent, but I am of opinion that there was dust there.

17106. Would you express the opinion here that had that section from the point of the main haulage way where the explosion turned off there had been dustless and damp, that the explosion would have continued through that part?—Well, as you came out from where the explosion commenced, the destruction was much more apparent, and the explosion has been more violent. It has come out to the shaft, and it may be it was the force of the explosion getting vent that caused it to go in there, probably with some small quantity of dust; but I am of opinion that it was the spending of the explosion, or the relief that the explosion had when it got to that point, that sent it in that way.

17107. From *that* point to *this* point it was going with the air?—Yes, excepting in the return, where it was going against the air.

17108. From the point of the explosion, where it originated, it went against the air to the pit bottom?—Yes.

17109. From this point it was going with the air current?—Through the stables, but in the return to this air crossing it was against the current.

17110. The blue line is the intake air current?—The explosion went through the stables, and that was an intake. The explosion went with the air to that extent.

17111. Are you of opinion that it had practically spent itself before going back through the stables way?—No, it had not spent itself. It spent itself in the shafts: but of course gathering in force as it came out that would be a relief for it.

17112. It went up a shaft at *this* point into the upper seam?—It went into the main coal.

17113. Do you know whether the main coal was dry and dusty; were you in it?—No.

17114. Do you know whether or not this shaft which went up to the main coal seam was a downcast or an upcast?—I cannot say.

17115. Do you know the shaft I am speaking of? It is called the Staple-up over?—I cannot say offhand whether it was downcast or upcast. It was open to the intake air, but I am of opinion neither one nor the other.

17116. (*Chairman.*) I think Mr. Armstrong said sometimes there was an updraught and sometimes it was stagnant, but there never was a downdraught?—That is my impression; it was neither one nor the other.

17117. (*Chairman.*) When there was a draught at all it was an updraught; that is what he said?—That might be so.

17118. (*Mr. Smillie.*) There was nothing to prevent the explosion coming up it? It was quite open?—It was quite open.

17119. There was also the downcast shaft open to the same seam and to the surface?—It spent itself in the shaft.

17120. It spread three ways. It went in at the downcast shaft?—Blew the separation doors off.

17121. Into the Staple-up over?—And to the main coal seam.

17122. And also back this stable way?—Yes.

17123. That is three points it went?—Yes. There was a man burned round *here*.

17124. Proving, of course, that the explosion had gone round *there* with some violence?—They get the flame *here*.

17125. Of course we may take it that in the Wingate explosion, as in other large explosions, the majority of those killed were not killed by either the force of the explosion or by burning, but by the afterdamp?—Yes.

17126. Have you considered whether or not, from your knowledge of Wingate and other explosions, something might be suggested to prevent death from afterdamp where an explosion has taken place? Could anything be done to save the men not touched by the explosion, but who will inevitably be poisoned with afterdamp?—If men could have sufficient presence of mind—taking the instance of Wingate explosion—to remain where the air is pure, then, no doubt, large numbers would be saved; but it is natural in the case of an explosion that they would try to get to the shaft. On the other hand, if you had means for men shutting themselves off, and they had the presence of mind to use it, that would be beneficial, but whether they would have sufficient presence of mind to use it or not I would not like to say.

17127. Was the upcast shaft in this case badly wrecked?—Yes, it was, in the neighbourhood of the Low Main Seam, where the explosion occurred.

17128. It is not shown here how the force of the explosion reached the upcast pit?—It blew the separation doors out between the two.

17129. That is how it got to it; it did not get round by the return airway?—It blew the shaft casing out.

17130. And by that means got into the upcast shaft?—Yes.

17131. May we take it the whole of the return airway was clear. If the men had been able to walk round the airway and keep before the afterdamp, they could have escaped in that way?—I do not think so.

17132. Had it not been that the upcast shaft was damaged; had it remained intact would it have been possible to get round the return airway?—There was no afterdamp beyond that point. This district was standing

Digitized by Google

Mr. C. S. Carnes.

17 April 1907

full of afterdamp, but beyond that there was no afterdamp, and most of the men who were coming out who were killed by afterdamp were *here*.

17133. They were coming out in the intake airway?—Yes.

17134. Supposing they had been able to find their way round the return airway and the upcast pit had been intact, could they have escaped if they did not require to come out through the intake?—Certainly they could. The four men that were saved were sitting here. (*Indicating.*) They came out from this district *here*. They were working *here*, and they came out with several others. Several of them came out and some would not go back. These four did go back and went *here*, and sat in that return.

17135. The afterdamp did not reach them there?—No. *This* air crossing was blown out, and *that* one was blown out, and *that* one was blown out, but they had this fresh air *here*, and remained there and were all right and were found about 8 o'clock at night.

17136. Do you think it would be a wise precaution to take to instruct the workmen in a mine as to the best way of getting to the upcast shaft in the event of an explosion taking place?—Yes. Of course in the County of Durham the deputies all travel—in the collieries I have had connection with—the returns every three months to the upcast shaft, so that they are conversant with the road, and if anything happens on the intake side they can come out and bring their men that way.

17137. The ordinary workmen miners do not do that and probably would not be able to find their way round?—No, I do not think they would.

17138. Unless assisted?—I do not think it would be practicable to do that.

17139. Did you examine the point at which this explosion took place?—Yes.

17140. How far was the jutting-out stone? Was it over one of the haulage roads?—Yes, it was on the side of it.

17141. Did it extend over the top of the haulage road? I should say from the position of it where I saw it placed in position afterwards, going past you might knock your head against it.

17142. We are told by Mr. Armstrong as a matter of fact it was a travelling road?—It was a travelling road, a main haulage road.

17143. A stone of that kind it would be desirable to get rid of in the interest of your haulage, and in the interest of the workmen passing to and fro, providing it could be got rid of with safety?—It is the same as a number of other projecting pieces of stone. There are a number of others on the same haulage road that you might apply the same remark to.

17144. It is a common thing for managers to get rid of boulders or jutting pieces of rock of that kind to clear them away from time to time where they occur?—No, if they are passed over in the first ripping, we do not usually do very much in that way.

17145. Providing they are not a danger in any way?—Yes. In the case of that stone I would do the same as Mr. Armstrong. I would not consider it necessary to send men purposely to fire a shot to take that piece of stone down.

17146. Do you think in all cases where a shot is to be fired in a main haulage road that it should not be fired without the written consent of the manager of the colliery?—Certainly I do.

17147. After he has made full enquiry into the whole circumstances?—Yes.

17148. (*Chairman.*) Or under-manager?—I would make it the manager.

17149. You say the manager ought to?—I should say the certificated manager.

17150. (*Mr. Smillie.*) Of course every precaution should be taken to prevent an explosion: that is, all precautions necessary under the present Rules?—Most certainly.

17151. At the present time it is not necessary that the consent of the manager should be given in writing or verbally?—Not by the Rules.

17152. It would be a wise thing that that should be done?—I think so.

17153. (*Mr. Ratcliffe Ellis.*) Have you had any experience in testing different kinds of dust?—No, I have not.

17154. Generally is your view that all dust pure and simple, is dangerous?—Yes.

17155. You agree, as you have said, that it would be desirable that an accumulation of dust should be prevented?—Yes.

17156. Would you be satisfied to impose upon the manager the obligation to prevent it in the best way he could, and leaving him discretion as to how he should do it?—Yes.

17157. You think that would be wise?—I think so.

17158. Whether he should take precautions to prevent it coming down the shaft or from his screens, you would not define in detail how he is to do it, but he is to keep the mine clear from a dangerous accumulation of dust?—Yes.

17159. You think that would be sufficient for the purpose?—Yes.

17160. Doing the best that could be done in that way in keeping it clear, there still must be some dust?—Except by complete watering.

17161. I will deal with that, but there must be some dust left?—Yes.

17162. Would you think it sufficient to protect the mines from the consequences of an explosion by having zones of one kind or another at different parts of the pit?—Without removing the dust?

17163. First of all we are agreed that there should be some general obligation to prevent as far as practicable any dangerous accumulation of dust?—Yes.

17164. You would have to remove it to comply with that. In addition to that would you consider it sufficient if you had zones instead of dealing with the whole of a mine by watering, or in any other way, that you should give the protection by zones?—I think it would be a benefit.

17165. Do you think that would be sufficient?—Remove the dust as far as possible.

17166. That applies to the whole of the haulage roads everywhere; in addition to that?—Provide zones which are absolutely dust clear.

17167. I will deal with that sort of zone in a moment. I am dealing with the difference between doing something with the whole of the haulage roads, or something with part of the haulage roads—zones. You think protected areas would be sufficient for dealing with the whole?—Keeping the dust down as far as practicable, and putting in these zones I think would be sufficient.

17168. There are some places where it would be absolutely impossible to water?—I quite agree with that.

17169. In Germany there is a provision "That in all mines water-pipes must be provided and maintained in a working condition, so that all parts of the mine used for coal getting, haulage, passage of men, or ventilation, can be watered for the prevention of danger from coal dust in accordance with the regulations contained in Paragraphs 34 and 35." That is a General Regulation that all parts of the mine are to be watered. There are certain exceptions, but generally the regulation is that all parts of the mine are to be watered. You do not approve of that?—No.

17170. You disapprove of that?—Entirely.

17171. You think no system requiring the whole of a mine to be watered is a practicable system?—It is not practicable, and it would be prohibitive in many mines.

17172. With reference to these zones, are there not some mines in which you could not have a watered zone?—Yes.

17173. It would bring the place about your ears?—Yes, it would.

17174. Apart from the difficulty of keeping up the roof causing danger, in deep mines where the heat is great would it not be very oppressive to the men working if you watered there?—Yes, it is oppressive when you do that.

17175. What is the deepest mine you have experience of?—1,500 ft.

17176. That is 500 yards. There are mines now worked at considerably greater depth than that?—Yes.

17177. Is it not the fact in the future the mines to be worked will be at a much greater depth?—Yes.

17178. Where the mines are at great depth and there is great heat, can the men work with anything like the comfort if the heat was damp?—It is very oppressive where the air is damp.

17179. Is that not an objection to watering?—Yes.

Digitized by Google

17180. You have mentioned the question of ankylostomiasis, but that is a different question. It would be very oppressive where there is a great heat to have it damp?—That I mentioned in regard to health. Of course "oppressive" would hardly come in as regards health; it would be uncomfortable.

17181. It takes a great deal more out of a man where the heat is damp, than if it was not so?—Naturally, yes.

17182. In cases where the zone cannot be watered, then you would recommend that protected areas should be made, rendering it free from dust?—Yes.

17183. Do you think you can clear an ordinary road sufficiently from dust as to provide that what is left is not dangerous?—An ordinary road—under ordinary conditions?

17184. Yes. I do not mean a specially prepared road?—I do not think you can.

17185. In order to have a protected zone, if you are going to deal with it by clearing it from dust, you must have special masonry constructed?—Yes.

17186. Take a mine at the depth you mention, 1,500 ft. Could you keep up masonry at that depth, do you think?—If you are working longwall and you put in masonry within a certain distance of the face, you could not keep the masonry up.

17187. The long-wall is the general system of working, is it not? It is the most approved system of working?—Not necessarily so. The principal method in the County of Durham is the board and wall.

17188. A modification of the pillar and stall?—Something like that.

17189. Where the long-wall system prevails you could not keep up these protected arches?—Not until a considerable time after the face has passed away from the entrance to that district.

17190. That is because of the great pressure?—Yes.

17191. Supposing you are working a mine underneath it?—Then you cause movement in your masonry.

17192. You could not keep it up?—Within a certain distance you would damage it.

17193. There is a difficulty in having a protected area cleared from dust, a specially constructed area?—Yes.

17194. There is difficulty in keeping up the construction?—Yes.

17195. With reference to the amount of dust left after you have cleaned an ordinary road, you do not know how much would be dangerous, and how little would be dangerous?—No.

17196. That is a matter to be decided by experiment?—Yes.

17197. You could not form an opinion as to the length of road to be watered or cleared from dust?—I could not form an accurate opinion.

17198. That is a matter that wants finding out by experiment?—Yes.

17199. Therefore you approve of the idea to have experiments to get this information?—Yes, I would.

17200. With reference to the Wingate explosion, your view, I understand, is that the blast went up the downcast shaft to some extent?—Yes.

17201. Was there any damage done in the shaft?—Yes, considerable damage.

17202. You think meeting the air may have done it but is it not in a different direction from where it would otherwise have gone?—I do not hold that opinion. It spent itself in the shaft, and had relief in this first East District to the extent it went in.

17203. That is your view as to why it went away from dust into a district where there is no dust?—I would not say there was no dust in that First East District. I am of opinion that there was some slight dust, although the bottom was damp. I do not think the top and sides were free from dust.

17204. (*Sir Lindsay Wood.*) The First East District?—The Stable District, I should say.

17205. (*Mr. Smillie.*) It is in the direction of the west way?—It is west. It is the Stable District.

17206. (*Mr. Ratcliffe Ellis.*) Was there any part of the district traversed by this blast which was wet?—The bottom was wet going into the stable way—damp.

17207. It did not stop it at any rate?—It did not extend any great distance into that district.

17208. Do you think the effect of the damp prevented it, or had any effect on the travelling of the explosion?—I think so. I think the lack of dust and dampness did prevent it—into that Stable District.

17209. Do you do systematic watering at your pits in part of your roads?—Yes.

17210. Do you consider that watering in order to be of any use, must be drenching with water, or do you think mere sprinkling is sufficient?—You must wash the dust from the roof and sides to be of service.

17211. Wash it off. Sprinkling would do no good there?—I do not think so.

17212. I wish to ask about the firing of shots In Durham are there three shifts working sometimes?—Three shifts of hewers in some collieries.

17213. Would there be an opportunity of firing shots between the shifts?—With three shifts working there would not be an opportunity. That is why I say it is impossible to do it.

17214. There is not a time when there are not some men working in the pit?—No.

17215. That could not be done there?—No, it is impossible to be done.

17216. Have you anything to suggest in addition to the rules as to shot-firing that exist now?—As an additional preventative?

17217. Yes?—Do you mean in the face, or do you mean on the main haulage roads?

17218. I should take the main haulage roads, because that is where the danger is?—Yes. As regards the main haulage roads I would not let a shot be fired without it was under a written authorisation from the manager.

17219. Anything beyond that? That seems to be common ground. Subject to that do you consider that the present rules are sufficient if carried out?—If carried out.

17220. Have you any suggestions to make?—If they carry the existing rules out, then they are sufficient.

17221. And have you any special method of instructing your shot-firers?—Nothing, excepting when they are authorised they are given a copy of the Act and rules.

17222. Do you give them any separate copy of the rules relating to their particular duties?—No.

17223. Does anybody instruct them, or are they told there are the rules and they must pick it up?—That is all. I think it would be an advantage if the rules relating to shot-firing were printed on the back of the authorisation.

17224. You think that would be an advantage?—I think it would be, because a man might read them where he will not read the entire lot.

17225. Are there any conditions under which you would prohibit shot-firing in the roads at all?—The main haulage roads?

17226. Yes?—Conditions?

17227. Yes; any state of things where you consider it unsafe to fire shots in the main haulage roads?—I would not fire them if there were any dust about. At Murton Colliery during the eight years I was there, there was not a shot of any description fired, because there was gas in the returns, and the main haulage roads were dusty.

17228. You have mentioned that. You agree there may be difficulties either in watering zones or in making dustless zones?—Yes.

17229. In such cases would you consider that safety was sufficiently provided for by prohibiting shot-firing in the main haulage roads?—I do not think it would be right to prohibit shot-firing in the main haulage roads altogether. If you did that it would prevent improvements in the ventilating of the pit which would be carried out if you could fire some shots.

17230. You would not consider it necessary to prevent them altogether. Would you think safety would be provided for if you put it under certain restrictions?—I think the present restrictions are ample.

17231. You have nothing to add to it. Do you agree with this. This is the Report made by Dr. Haldane and two Inspectors who recently visited Germany. They say: "In view of the results of the watering regulations in Westphalia mines and the circumstances in this country, so far as they are yet known to us, we submit that it is desirable for the Commission

Digitized by Google

Mr. C. S. Carnes

17 April 1907

to consider whether thoroughly efficient watering of the floor, sides and roof is not required in English coal mines which are dry and dusty. For the present, at any rate, such watering might be made compulsory only in the case of the haulage roads, men's travelling roads, and intake roads of any kind in which dry coal dust (from surface or elsewhere) is present. In some cases it might be found that watering sufficient to keep the roads free from dust would seriously injure the roof, floor or sides, and to meet such difficulties the following conditions have suggested themselves to us as an alternative: (1) The seam to be worked with safety lamps. (2) When shots are fired in any part of the seam, all workmen to be removed from the seam and from all seams communicating with the shaft on the same level except those necessarily present (not exceeding 10) for the purposes specified in General Rule (1), (2). (3) Where one haulage road joins another, dustless spaces at least 50 yards is length to be constantly maintained in every direction from the point of junction, and wet and dustless spaces, at least 100 yards in length, to be maintained at the far end of every haulage road." Leaving out the 50 yards and the 100 yards which have to be enquired into, do you generally agree that those recommendations would be sufficient in cases where it is impossible or impracticable to water?—I would not agree with that at all except in so far as the zones are concerned.

17232. Which do you not agree with, the seam to be worked with safety lamps?—So far as dust is concerned, I do not think that there is any necessity to put in safety lamps. Safety lamps would apply as regards gas only.

17233. You think these are unduly stringent?—Yes.

17234-5. The only thing you consider should be done is that there should be protected zones, but where they could not be either watered or rendered sufficiently safe by being dustless, you think if the Regulations existing as to shot-firing are strictly observed that will be sufficient for safety?—Quite.

17236. Have you had any experience with rescue apparatus?—No, I have not. But take, for instance, Wingate; you could not have got through places where there were heavy falls, with so cumbrous a thing as a rescue apparatus on your back—certainly not with some kinds of apparatus. You could not squeeze through any small space similar to what I saw at Wingate.

17237. Is your view, from what you saw at Wingate, that there would have been no advantage if rescue apparatus had been in use there?—I do not think it would have been any advantage.

17238. In that particular explosion?—No.

17239-40. I want to ask you one question about the cost of watering. This cost you have made is a very rough estimate?—It is what it is actually costing us now.

17241. In those roads you have where you cannot water, if you attempted to water there, there would be the additional expense not only of keeping up the road, but you would impede the work of the mine?—If we watered.

17242. That you cannot water?—No, because you do not know what damage you do.

17243. (*Mr. Wm. Abraham.*) You are of opinion that an accumulation of dust in roadways, or anywhere, should be prevented?—Yes.

17244. You would not allow dust to lie on the roadway or the bottom thereof 3, 4, or 5 in. thick?—I would not.

17245. What would you have done with that?—If it was possible to water I would water. If it is not safe, which in many cases it is not, to water, I would brush it off the roof and sides, and rake it up and put it into tubs.

17246. I was just dealing with the bottom, with the travelling roadway. What would you do to prevent the accumulation of dust on the roadway, not on the side and on the top?—The source of that dust is from the trams and from the screens, principally.

17247. My question was what would you do to prevent the accumulation of it?—Make your tubs as far as possible dust tight.

17248. I want to get to the practical point, if we possibly can.—Make the trams as far as possible dust-proof.

17249. In no case would you have dust of the thickness of 3 or 4 or 5 in. lying on the road?—I would not, if I could prevent it.

17250. Supposing you could not, would that be a place where you would water?—If the stone would allow, but in some cases you would create a greater danger by watering.

17251. Which would be the greater deterrent to the men working there, having it watered or allowing that thickness of dust to lie on the road where they are working?—In some cases the watering would be the worst.

17252. As affecting their work by the depressing state or condition of the place where the men work?—In a very dry and dusty mine the watering would have more effect on them than leaving the dust.

17253. We are dealing with the roadways?—Yes.

17254. Have you seen a case in all your experience where watering roads has ever affected the health? I mean artificial watering. We make a difference between that and where mines are naturally damp?—Yes.

17255. Do you remember a case where men are working where you are obliged to water that roadway to such an extent that it made it uncomfortable or unhealthy for them to work in?—No, I do not know of such a case.

17256. Which, in your opinion, would be the worse for them, to water the surface of that dust or to allow them to kick it about while they are working?—As I say, if the stone would allow it, I would most decidedly water it.

17257. My point is as to the health of these people. Mr. Ellis has asked you to-day about this watering where the men are working. I want you to come to this practical point: I want to know what happens in practice, not in theory. We are on the roadways now, and I think we understand one another?—Yes.

17258. The question is whether watering the coal dust moderately on the surface, or the men being allowed to kick it about while they are working would affect their ability to work and their health?—With the men working on the main haulage road it would be better for them if watered: the dust would affect them more. On the haulage road, mind.

17259. You would not have this condition of things in the face?—No.

17260. So that the watering that we are talking about that you have been examined with regard to to-day, is affecting the comparatively few that are working on the travelling roads, if it is at all. You have not touched the number of men that are working in the face?—If you water very completely and extensively on the main haulage road, then you will moisten the air, and when that air gets into the face it will be very oppressive for the men working there.

17261. Would not that moisture be dried up before it reached the face?—I should say not. Where you have it very warm my experience goes that it would not be so.

17262. If it is very warm is it not likely to dry up before it reaches the face?—I have not known it do that. It has been moist and very oppressive.

17263. If you did not water a place which requires to be watered to that extent, it would affect the condition of air? Would that not be likely to have a great effect, if not a greater effect than the raising of the dust carried by the wind?—If the dust was carried into the working places it would be very uncomfortable.

17264. After all it is six of one and half-a-dozen of the other?—Yes. I should say it would be sufficient if there was a rule that it had to be left in the manager's hands that the dust had to be kept free and he had to adopt one means or the other which you named to meet the special case.

17265. After all, there is no greater danger to health to the general body of men that you employ from watering than allowing the dust to accumulate without being watered?—The dust would affect their health; there is no doubt about it.

17266. How far would you make it compulsory upon the management to keep the roadways clear from dust. Are what we call here general obligations sufficient, do you think?—To keep the main haulage roads free from dust?

17267. Yes?—I should say so.

17268. General?—Yes.

17269. Would they not be expected to do it now where they have a very dry and dusty colliery?—The rules do not make it compulsory that they have to do it.

17270. Then to that extent you want a new Rule?—Yes.

(*Mr. Ratcliffe Ellis.*) That we are agreed upon.

(*Mr. Wm. Abraham.*) That would not be met if the present rules were not altered.

(*Mr. Ratcliffe Ellis.*) No.

Digitized by Google

(*Witness.*) So far as dust is concerned, exactly: but so far as shot-firing is concerned, the present rules do.

17271. (*Mr. Wm. Abraham.*) That is clear. In your opinion you say it would be impossible to maintain constructed areas within a considerable distance of the surface?—If you are working long-wall of course you have a crush and a movement for some considerable distance back.

17272. How near in point of distance and time would you go working to the face where you need to have these constructed?—To construct zones?

17273. Yes, either wet or dry?—How far you will have the constructed zones from the face?

17274. Yes, how far you could maintain them without any danger to them?—How close to the face could you construct them?

17275. Yes?—I should not say you could maintain them within three-quarters of a mile at least of the face. You would have movement back for three-quarters of a mile at least from the face.

17276. Would not the general conditions of the strata be of a very frail character indeed to need three-quarters of a mile?—You would get movement in long-wall working with any thickness of seam for at least three years. It would not come finally to rest in long-wall working with a seam of 4 ft. and upwards, under three years. At least that is my experience.

17277. Take that as an average, if you like, three years working from a face three-quarters of a mile distance: you could then do it at a fair cost. I do not mean without any cost whatever, because the thing itself will cost money: but fairly without any extra cost?—You could put in arches.

17278. You could put in arches with safety?—With comparative safety.

17279. I think at the close of your evidence in chief you said that if there was a rule that no individual should be allowed to carry both the explosives and the means of firing them, accidents would be reduced or prevented—it would tend to lessen accidents?—You would then have to have two men to break the rule instead of one.

17280. In your opinion that is necessary?—It would be an advantage.

17281. It would tend to reduce accidents?—Yes, that is my opinion.

17282. So far, then, you think that that is necessary?—If you take Wingate as a typical case, that explosion would not have occurred.

17283. I know of other cases?—We have talked a good deal about Wingate.

17284. I know other cases which you are not acquainted with?—Yes.

17285. You do not think it is prudent to allow the miner to have charge of the explosive necessary for the shot, and the means of firing it?—I would not do so.

17286. You think that it is necessary to prevent some accidents taking place that that should be so?—I would not let the one man have the two, not in a dry and dusty mine.

17287. In a dry and dusty mine, of course. Have you rules in Durham to that effect?—No.

17288. It is the common sense of the management that works it out?—There is no rule to that effect.

17289. Then in your opinion there would be a great benefit from having a new rule even there?—Yes.

17290. Then you would have no shot-firing on the main roads of any kind without having a competent man to do it, and the place being examined before the shot was fired by his superior?—Yes.

17291. Is that in the rules at present?—Not the latter point.

17292. In that case you want a new rule?—That would be an advantage.

17293. You would modify the opinion that you have given here, that if the present rules were carried out these accidents would not happen?—Putting it in that way, of course.

17294. (*Chairman.*) Do you wish to say anything more?—No.

Mr. Simon Tate, called and examined.

Statement of Witness.

17294A.—1. The evidence that I propose to place before the Royal Commission on Mines goes to show that with proper care explosives can be used with safety in all coal mining operations. In the coal mines immediately under my charge, viz., Trimdon Grange, Trimdon and East Hetton Collieries, we last year (1906) had an output of 716,055 tons; the deepest seams are dry and dusty, and come under the designation "fiery," as they give off considerable quantities of firedamp; the upper seams are wet and free from dust.

2. The seams are thin in section and hard in nature, necessitating the use of explosives both in blasting the coal and the making of height in the stone above and below the coal seam.

3. At these collieries, during the last 12 months, over 170,000 shots were fired in coal and stone, which was one shot for every 4¼ tons of coal mined, and the total quantity of explosives used was 30·338 tons, and during this time we have not had a single accident of any description arising from the use of explosives in shot-firing. The only accidents we have had during the last 24 years are one fatal accident, due to the premature exploding of a gunpowder shot, and five other cases of serious personal injury, and these were all through carelessness and neglect. In all these latter cases the accidents happened with high explosives. I think there is no doubt that on the introduction of the high explosives into general mining use the men were extremely ignorant of the method of using and handling these explosives, with a result that a lot of accidents occurred. In recent years, however, accidents from these causes seem to be reduced to a minimum, which is due entirely, I think, to the increased experience of the men in their use.

4. For many years I have been fully aware of the danger attending the indiscriminate firing of shots in coal mines and more especially on "main haulage" roads. I have tried the various methods of dealing with coal dust, such as ranges of water-pipes laid along the main haulage roads and taps fixed at intervals of every 20 yards or so, and lengths of hose piping used to enable the whole surface (top, floor, and sides) of the roads being watered. This system, however, I had to abandon, as, owing to the effect of the water upon the roof and sides, which began to fall, and the floor to "heave" it became very dangerous to continue its use; and not only this, but the action of the water upon the wood and iron supports was very detrimental, rotting and causing decay in the former and corroding the latter. My experience of watering also goes to show that its beneficial effects are of very short duration, as the dust is very often all washed from the roof and sides and deposited on the floor, and then becomes dry again and is more objectionable and dangerous than before.

5. I have had the sweeping up of the dust from the top, floor and sides of the main haulage roads carried out, but I found this almost futile, and in many cases the danger is increased by the very operation of sweeping, as large clouds of dust are raised and carried forward by the air current and redeposited further inbye; moreover, I have found that in the course of a few days the surface that has previously been swept, again shows a sufficient deposition of dust to be dangerous.

6. I have been reluctant to sweep coal dust up on the engine plane, as this can only be conveniently done after the hours of coal drawing, at a time when a large number of shots have to be fired by stonemen. I have felt that it increases the danger instead of diminishing it; in fact, it enhances the danger, as, owing to the action of sweeping, clouds of very fine dust (which is the most dangerous) are thrown into the air current, travelling at a high velocity, and in this way the dust is carried for a

Digitized by Google

Mr. S. Tate.
17 April 1907

considerable distance inbye, thereby constituting a danger at places where otherwise shots might be fired with perfect safety.

7. In all the explosions which I have investigated I have found that, in cases where the explosion has originated and travelled any distance to points on a main haulage road where men have been engaged in the cleaning up of coal dust, the explosion seems to have become strengthened and still carried further on.

8. I consider that with due care shots can be fired wherever gas is not present in greater quantity than can be discerned on the flame of an ordinary safety lamp, provided that in cases where it is dry and dusty all places are watered immediately before, for a distance of at least 20 yards, all round the point at which the shot is to be fired.

9. In all my experience I have never known an explosion occur on a main intake where the road in the immediate vicinity of the shot has been properly watered. In fact, if the Coal Mines Regulation Acts and Special Rules in force at each colliery in this county are strictly carried out it would be well-nigh impossible to get an explosion of coal dust. To insure the safe carrying out of the Act it has been my practice to appoint competent men as shot-firers, but even these men are only empowered to fire shots in particular districts, and never on a main haulage road, unless they are specially authorised to do so by the manager, whose duty it is to ascertain before any such shot is fired that the enactments of Coal Mines Regulation Acts and Special Rules of the colliery are fully carried out.

10. We also fix notices warning all the workmen employed below ground of the danger attending the non-compliance with the Coal Mines Regulation Acts and Special Rules, &c., with respect to shot-firing. All the men who are authorised to fire shots are bound every day to sign their names in a book and give the number of shots to be fired and the district in which they are to be fired; this is an additional precaution, and has the advantage of allowing the management to check every individual shot that is fired.

11. In all cases where it is necessary to use safety lamps the firing of shots should be performed by men carefully selected for their experience of the work and knowledge of the Coal Mines Regulation Act and Special Rules pertaining to shot-firing.

12. If an explosion did take place in a mine, I firmly believe that if a sufficient length of the main roadway, say, of about 100 yards, was kept free from dust and watered, it would be sufficient in all cases to extinguish the flame of an explosion and prevent its further extension. My reason for this is that I have never known an explosion travel over a wet road of even a shorter distance than this. I would place these "wet zones" immediately on the entrance to each district, and in the case of main haulage road, extending more than a distance of a thousand yards beyond the "watered zones." I would, in all cases, have another zone at the inbye end of the haulage road.

13. In the event of the water having a prejudicial effect upon the road, I would have these portions properly protected by masonry, if such was necessary.

14. I consider that the loss of life from an explosion could be very much minimised if, when an explosion does take place, the men who are in the mine and who are unharmed by the blast could seal off the portion in which they are working from the parts to which the blast has penetrated. Some years ago I read a paper before the North of England Institute of Mining and Mechanical Engineers, a copy of which I enclose, on the saving of life from after-damp, smoke, or fumes in mines. Briefly, the suggestion put forward in my paper was to seal off, by means of doors, all portions of the mine which the blast of the explosion had not penetrated, to secure the uncontaminated air in any particular district and keep out the deadly afterdamp, which claims so many lives. The idea was very favourably commented upon by the mining engineers present when it was read. In disasters such as that which took place at Courrières in France, I think that a large number of lives would have been saved by the adoption of such a method.

15. It is a well-known fact in nearly all explosions of firedamp and coal dust, that most of the lives are lost by the effects of after-damp resulting from the explosion. I think, therefore, it is advisable for me to put before you the above suggestion for minimising the loss of life from such a cause.

17295. (*Chairman.*) You are a Mining and Mechanical Engineer, Mining Agent for Walter Scott, Ltd., at their Trimdon Grange, Trimdon, East Hetton and Scotswood Collieries, also Mining Agent for the owners of Hamstell's Collieries, and for the Dunston Garesfield Collieries, Ltd., and a Member of the North of England Institute of Mining and Mechanical Engineers, and of the Institution of Mining Engineers. Then you say that with proper care explosives can be used with safety in all coal mining operations, and then you show that an enormous number of shots were fired during the last 12 months, over 170,000 shots in coal and stone, which was one shot for every 4¼ tons of coal mined, and that the total quantity of explosives used was 30,338 tons, so that you have had an enormous experience in the use of explosives. You then say that you have only had one fatal accident during the last 24 years, and five cases of serious personal injury; in all these latter cases the accidents happened with high explosives. You think that the first men were extremely ignorant of the method of using and handling these explosives, and accidents from these causes you say are now reduced to a minimum. Then you say in the mines with which you are concerned there is practically nothing further that need be done, or can be done, to diminish accidents than those precautions which you at present take?—That is so.

17296. You have nothing whatever to suggest with regard to increased precautions as regards your mines?—I think we take all the precautions necessary.

17297. You have heard what Mr. Abraham said to the last witness. Do you agree that the Rules might be strengthened in the way that the last witness suggested?—In my own experience I have strengthened them somewhat in the manner that Mr. Abraham spoke of.

17298. You do take care that there are two people, one to carry the explosives and the other with the means of firing them?—We have established the fact that no one but a competent man shall fire shots and not the man, whose livelihood is dependent upon the mineral gotten.

17299. I do not know that that covers Mr. Abraham's point. Mr. Abraham suggested that there should always be two people whenever shots were fired, one to carry the explosive, and another the means of firing it, in order, as the last witness says, that accidents might be reduced, because it is less likely that two men should combine to disregard the regulations than that one man should do so?—In practice that occurs in this way: the man who is getting mineral, or whose duty it is to put the shot in, is there as well as the man who fires the shot, and he takes the explosives in with him. The man who fires the shot only takes the detonators, so that there are two men.

17300. There are two men concerned in firing a shot?—Yes.

(*Mr. Wm. Abraham.*) That is a point that I should like to have made clear.

17301. (*Mr. Ratcliffe Ellis.*) Do you fire shots by electricity?—Yes.

17302. The man who fires the battery connects it?—Yes. We always have two. The same man who ignites the shot or touches the battery must attach it. We will not allow two men to interfere with it. The man as a rule in whose place the shot is fired carries the explosive, but the man who fires the shot carries the detonator and the battery.

17302A. (*Mr. Wm. Abraham.*) That is the point. You do not allow the miner who bores the hole and who carries the explosive to deal with the detonator at all?—We do not.

17303. (*Mr. Ratcliffe Ellis.*) I do not think in your case the miner carries the explosive?—Yes.

17304. (*Mr. Smillie.*) Does he stem the hole?—Not in all cases. As a rule, in the permitted explosives, the shot-firer stems the hole, but in the case of stone work the stone-man stems the hole; the miner does not stem the hole.

17305. You say he carries the explosive?—The explosive is his property. He gets it from the powder-house, from the explosive store, and takes it in, and he carries it; but he hands it to the man who is going to fire the shot to put it in, and they generally consult about the amount of explosive.

17306. (*Mr. Wm. Abraham.*) Does he get the detonator?—No.

17307. The man?—The explosive.

Digitized by Google

17308. He gets the explosive from the stores ?—Yes.

17309. He does not get the detonator ?—No.

17310. The other man brings the detonator with him ? —Yes.

17311. So that the miner cannot hand it over to him ? —Not the explosive—not the detonator. He hands the explosive to put it in the hole.

17312. In certain cases where he rams the hole ?—The miner bores the hole and makes it ready for the shot-firer. When the shot-firer goes he says, "Where is the explosive ?" or "Where is your shot ?" is a common expression, and he puts it in and stems it, and attaches the battery and fires it himself.

17313. (*Chairman.*) He does not bring the explosive ? —No, the explosive is in the place all the time with the man who takes it in.

17314. (*Mr. Wm. Abraham.*) In your opinion a rule to that effect making that compulsory would reduce the accidents from shot-firing ?—Well, I would not say that so much, except that it is my practice to do that.

17315. Surely you have some very good reason for that practice ?—We think it is better; that is all.

17316. You think it is safer ?—I do not know that it is necessary for a rule.

17317. It is safety of life we have to consider here first. I put it to you that those good practices are based upon what you think is necessary to reduce accidents in mines ? —That is what we have done, anyhow.

17318. (*Mr. Ratcliffe Ellis.*) Is there any other practice than that ? Does a miner ever take down the cartridge and detonator ?—Not in our deep mines now, very few. They did in this particular case at Wingate, but that was rather different. There was a little point there which Mr. Armstrong did not get out. At the commencement of the shift one man held the detonator and one the cartridge, and it was only when one man was instructed to work apart from the other and where explosives were not required, that he handed the detonator to the other man, so that he held both explosive and detonator; this was contrary to the Rules of the Colliery.

17319. In your case the shot-firer has in his hand the cartridge and in his pocket or box the detonator ?—Yes.

17320. When the collier hands the cartridge to him for the moment he has both detonator and cartridge ?— Yes, that is all.

17321. The General Rule is that the collier takes the cartridge, but he has not the detonator ?—No.

17322. (*Chairman.*) If that is always so, there would be no harm in making it a General Rule or a Special Rule.

(*Mr. Wm. Abraham.*) That is my point.

(*Witness.*) There could be no objection to it being a rule.

17323. It is not an objection. I have no right to give evidence, but I can point out a number of collieries where I know as a fact that this takes place. Do you not think in the interests of safety we had better have a rule ?— You put it in that way—if there is anyone who does it.

17324. (*Chairman.*) If it is a universal practice that ought to be followed, surely it would be as well to make it a General Rule for what it is worth. Of course, a General Rule may be broken, but it might be as well to make it law ?—I might say that where gunpowder is used it is different. In those mines the man takes the means of igniting and everything else.

17325. (*Mr. Wm. Abraham.*) That is not a dry and dusty mine ?—No.

17326. (*Chairman.*) Now we will go on with the question of watering. You say that you used to water with taps fixed at intervals of every 20 yards or so and lengths of hose piping, but that you abandoned it because of the nature of the strata. Supposing you found that the strata would stand watering, you would not prevent it; it is merely on account of the strata being such as not to stand watering at all ?—The great majority of mines you cannot water. The mines are very few indeed that you can water thoroughly—that is, roof, sides and bottom.

17327. You very often water the bottom where you cannot water the roof and sides ?—We do.

17328. Wherever you reasonably can water without the floor heaving too much you do so ?—We would do so.

17329. You go on to say, "My experience of watering also goes to show that its beneficial effects are of very short duration." Mr. Carnes said his experience taught him that watering once a week was sufficient ?—That is a pretty long period, once a week. The effects very often work off before that when there are strong currents of air passing.

17330. It depends upon the currents of air ?—And the temperature of the mine.

17331. Very often you would have to renew the watering more than once a week ?—Yes, oftener.

17332. Then you go on to deal with sweeping up the dust, and you say that there is very little use in that, because large clouds of dust are raised and carried forward by the air current and redeposited further in-bye, and that you have often found in the course of a few days the surface which has been previously swept again shows a sufficient deposition of dust to be dangerous. Therefore, some say, there is not enough good to be got out of sweeping up the dry dust. You must have some damp ? —It really wants to be combined. Where it is not safe to water roof and sides it should be dusted down and the floor watered.

17333. The dust, naturally, if taken off the roof and sides, would have a tendency to fall on the floor, and most of it would find its way on to the floor and would not be carried by the air current. A great deal of it would naturally find its way to the floor ?—The point is that it does lengthen the dangerous ground, because it does pass further in than it would in great quantities like that.

17334. On the other hand, the dust would consequently be deposited on the floor ?—My idea is this: if proper precautions are taken there is no danger in the dust. If, when you fire a shot, you carried out the Rules, there would be no danger, because you would not fire a shot where it was dusty without watering.

17335. There is not so much danger in allowing dust to accumulate in mines as long as you comply with the law in watering round a shot when it is fired ?—I have known a large number of explosions, and I have never known an explosion happen where round the shot it was properly watered for the distance specified by the Act of Parliament. I have had experience in 12 colliery explosions, extensive experience, and I have investigated them all, and I have not known an explosion happen where the precautions as set forth in the Act of Parliament have been carried out.

17336. Are these mines gaseous mines ?—Yes. We have had a very heavy explosion there before I went, 23 years ago, when 70 lives were lost.

17337. You might have an explosion by the breaking of safety lamps ?—You can, but we do not as a rule allow any person to work where there is gas present.

17338. By some accident gas explosions are sometimes started by the breaking of safety lamps, and in that case I suppose the accumulation of dust renders the explosion much worse, because it would carry it on, whereas it would not be carried on in the absence of dust ?—If you had an explosion dust would increase it very seriously.

17339. Therefore, there is some danger in gaseous mines at all events, in not removing dust even though you watered round every shot that is fired ?—Yes. Looking back over 30 years in the County of Durham, I have not known one to happen from a shot.

17340. Not from the breaking of a safety lamp ?—No, it has not been my experience, and I have investigated all the large explosions in the county.

17341. However, you do a great deal in the way of sweeping up the dust ?—We do.

17342. You think it is almost an unnecessary precaution as regards explosions, but that it may be well to do it for the health of the miners or for their comfort ?—Yes; the less dust you have the better for explosions. There is no doubt about that.

17343. Then you say that coal dust cannot be swept on the engine planes conveniently except after the hours of coal drawing, and you go on to say that if the Coal Mines Regulation Act and Special Rules in force at each colliery in the county are strictly carried out, it would be well nigh impossible to get an explosion of coal dust. However, you do go on to give certain suggestions, particularly one I am coming to about doors. You say where it is necessary to use safety lamps the firing of shots should be done by men carefully selected. How would you take care that the men were cognisant of the Rules, and that these selected men knew the Rules applicable to shot-firing ?—The permits to fire shots that I give out to the men firing shots have the Rules printed on the back.

Digitized by Google

Mr. S. Tate.

17 April 1907

17344-6. The full Rules?—Yes.

17347. You say you firmly believe, if an explosion did take place, that a wet zone of 100 yards or even less would stop the explosion?—Yes.

17348. Some doubt seems to have been thrown upon that theory by Mr. Armstrong in the case of the Wingate explosion. However, we have had two different versions of that. Mr. Armstrong believes that the explosion, which was a very violent explosion, made its way through more than 200 yards of wet and dustless zone, but, on the other hand, Mr. Carnes says that the zone was not wet and dustless. What is your opinion upon that point?—I went into that mine, and I was in charge of the shift when I found those men that were rescued. I reached them first. I came out and went into that stable-way, and my opinion, if asked, was I would say 200 yards from the road end was certainly dusty.

17349. And dry?—And dusty. 200 yards from the out-bye end, that is nearest the shaft, was dry and dusty, but at the innermost point near where the man was found who was burned it was wet.

17350. That would only be about 50 yards or so from the end of the dry and dusty part?—It is not more.

17351. All that is shown by the Wingate explosion is that a strong explosion may travel more than 50 yards through a wet zone?—It would not be 50 yards from where it was wet to where the man was killed.

17352. Less than 50 yards?—Yes.

17353. Your principal suggestion seems to be that you would seal off by means of doors (and I think you read a Paper on that subject) all portions of the mine which the blast of the explosion had not penetrated, to secure the uncontaminated air in any particular district and keep out the deadly afterdamp which claims so many lives. Perhaps you will explain to the Commission how you would make use of these doors?—Might I just first say what caused me to come to this opinion?

17354. Certainly.—I took part as one of the explorers in the Seaham explosion, and in the Seaham explosion there were 160 lives lost. Of the whole of that number 122 lost their lives through afterdamp. Shortly after that I was called in to other explosions, and it then gave me considerable anxiety how to obviate this, because I found that in the Seaham explosion that as we were trying to rescue the men the very efforts we were putting forth to rescue them were shortening their lives in this way. The Seaham Colliery was divided into large districts, and each district until we tried to penetrate it was standing with the afterdamp on the out end of the district, and when we put the fresh air into that district we drove the afterdamp in on to the men who were living and killed them.

17355. The vitiated air would not have killed them. They might have lived in the vitiated air?—They did live a considerable time. Several of them left records hours and hours after.

17356. Could you have got at them?—We got at them.

17357. Could you have got at them without turning the fresh air?—No, we could not.

17358. You could not have saved their lives anyhow?—If they had sealed themselves up with the fresh air existing at that particular portion of the mine and we had gone in, the vitiated air would have passed out of the return and we should have saved those lives. That was the case at Wingate. At Wingate explosion the men came out of the face, and when they got so far out they met the afterdamp and were killed, but some of them retreated back into the district, and with the crossings and stoppings being blown out the afterdamp passed into the return and they lived until we reached them upon just the air standing in the mine, but if the afterdamp had gone in these men would have lost their lives.

17359. If you had had a rescue apparatus could you have got to the men and told them what to do?—We could if we had a rescue apparatus; we might have told them what to do. We might have reached the doors and put them in. It would be better if they had put them in themselves. If there was a means of closing the door they would be perfectly safe.

17360. You can understand there may be cases in which rescue apparatus might be very valuable?—I have never seen one. As a rule the mine is knocked all to pieces, and most of the rescue apparatus are very clumsy and cumbrous for carrying about. I have used them. We used them at Seaham for the purpose of putting in the stoppings. In the presence of gas we could not drive it back until we had the stoppings arranged.

17361. They were useful for changing the ventilation?—For assisting in restoring the ventilation.

17362. You could conceive a case where you could tell a man what to do by means of the apparatus?—It would take another apparatus to get him out.

17363. You might tell him what to do or where to go.—There is no place to go.

17364. You might tell him to remain there?—He might remain there.

17365. (*Mr. Ratcliffe Ellis.*) It must be an advantage to be able to communicate?—Yes.

17366. (*Sir Lindsay Wood*). I think you said that in many accidents from shot-firing the watering had not been properly done in the first instance?—I have never known one where the watering has been done.

17367. Where the watering is sufficiently done?—I have never known where it was done.

17368. Not even attempted?—It was reported in one it had been attempted, but it was quite dusty when we reached it.

17369. Do you think that is due to the want of belief in the necessity of watering round a shot?—I think so, I think it was in a great measure.

17370. Is it the effect of dust exploding from a blown-out shot or is an explosion of dust not sufficiently believed in by Durham people?—It was not believed in, and it was not even believed in by the officials until recently. Due importance has not been given to the danger of firing shots and wetting the surrounding area.

17371. The dusty area?—Yes.

17372. That is becoming much more known now?—Yes, now. I am quite sure that more people believe in dust explosions now than they ever did. We fire shots continually at times on the main haulage roads, but we never have any accidents. Of course we always water.

17373. On the main haulage roads?—Yes.

17374. You would not have a law preventing all shots on the main haulage roads?—Certainly not, I think it would do more harm than good, because we have to improve our roads. As our mines extend we have to enlarge them and make more room for haulage purposes, and it would be more serious not to fire shots than to fire them, but only fire them under proper precautions.

17375. The mines in Durham are not excessively dusty?—No.

17376. They are not like the mines in South Wales?—No, the mines in Wales are much more dusty than in Durham. There are one or two mines in Durham which are somewhat dusty, but not nearly so dusty as the mines in South Wales.

17377 In many of the deep and dry mines there is coal dust above the dust of the thill?—I have not known an explosion happen on a horse road. All the explosions I have known have happened on the engine roads, never where the horses were treading up the floor of the mine.

17378. Due to grinding up the thill on which they walk and mixing it with the coal dust?—Yes, and there is another thing, that the dust is not so fine there as it is in the sets where the engines are travelling at a great rate.

17379. The draught of the wind drives the dust off the tubs more than it would on the horse roads?—Yes.

17380. Do you think there could be much done in the prevention of dust going down the shafts?—Yes, I have recently, instead of ordinary pulley frames on the pit-head, built brick erections for carrying the pulleys. I am putting doors on up to the heapstead level, and that keeps the dust out.

17381. Even above that?—And we could put closed gates on above the heapstead level and thus separate the shaft from the atmosphere up to the level of the pulleys.

17382. At the pulley frames?—Yes, there is nothing to prevent that.

17383. Are the downcast shafts damp or wet?—Yes, the majority of the mines are damp with water trickling down.

17384. That prevents the dust going in-bye?—It does in a great measure.

17385. Do you think there are many places where there is much dust which gets in beyond the shaft sidings. It goes down the shafts, I think?—I do not think there is.

Digitized by Google

17386. Unless the shafts are very dry?—Unless the shafts are very dry.

17387. Do you think the zones would be efficient?—I think they would tend to do good for the prevention of the continuation of an explosion. I think they would prevent it spreading.

17388. It might possibly limit the extent?—Yes.

17389. You cannot say it would limit the extent?—That is another thing. Take Wingate—I only mention it as the most recent one in my experience. The explosion did not pass over a single damp place.

17390. It killed a good many men on the wagon way?—All the men killed were on the wagon ways practically in the different seams. The men were not working in the wagon ways, they were passing along the wagon ways and were killed by the afterdamp.

17391. They were not killed by the force of the explosion?—They were killed on the wagon way, but not far from the shaft. Some of these men would travel half an hour before they reached the scene of the explosion and were killed.

17392. Had the afterdamp not gone in?—That is what I pointed out. The crossings and stoppings were blown out and it passed and went through to the upcast pit, to use a pit phrase, the in-bye end was laid dead.

17393. (*Mr. Smillie.*) It was cut off altogether?—The air was passing through the nearest roads and going direct into the returns.

17394. (*Sir Lindsay Wood.*) Have you had any experience of the cost of watering?—Not of the cost, but at one of my pits 10 or 12 years ago we had water pipes laid on for hydraulic purposes, and I thought it was a good opportunity for watering the roads. I fixed taps every 25 yards and had a hose, and we continued that for sometime until I found that it had a most detrimental effect on the roof. I was obliged to abandon it. It was a blue stone roof and we had to commence to timber where we had never timbered before, and that road has never been the same since.

17395. (*Chairman.*) Have you not watered the floor ways?—We have continued to water the floor to keep the dust down.

17396. (*Sir Lindsay Wood.*) I think you were once employed at Hetton?—I was; I commenced shortly before the big explosion at Hetton.

17397. Do you remember the Jane pit bank?—I do.

17398. A good deal of water got into that. You could not form any idea of the cost of watering that?—I think it would amount to a large sum of money.

17399. It went on for some years?—I remember it. I remember when they were drawing up to 40 scores of stones out of the bank on a Sunday.

17400. What is that?—40 by 20 is 800 tubs of stones that would be over 300 tons of stones drawn just for maintaining that one road.

17401. You think if zones were put in and kept watered, and there were strict rules as to firing shots on wagon ways that it would be the means of stopping a good many explosions?—I think it would, because I have never known explosions happen where the Rules have been carried out, and where accidentally there have been wet zones.

17402. You have been fairly free from explosions?—It is a remarkable thing that the explosions have been at the best-managed collieries. They have been at the collieries that have had the highest ventilation, as a rule.

17403. (*Chairman.*) You think the ventilation sometimes tends to make an explosion more violent by bringing more oxygen to bear upon it?—There is no doubt about it. I think even the high current passing at the point of ignition tends to increase the possibilities of igniting, of starting the explosion. The particles of dust are carried to each other quicker than they would be where there is a slackness of air.

17404. Explosions generally go against the air current?—Yes.

17405. The strong air current feeds the explosion, and at the same time retards it?—Yes, there is no doubt the stronger the air current with dust the heavier the explosion.

17406. (*Mr. Wm. Abraham.*) I gather that it is your opinion from long experience that the more perfect the air the greater the danger from dust?—The greater the force of the explosion, at any rate.

17407. For the same reason, would not a good strong current of ventilation carry the dust with it in the air?—Yes.

17408. You have been in the habit of watering the roads in order to prevent the dust flying away in the current of air and causing discomfort to the men?—Yes.

17409. Would the discomfort to the men be greater, in your opinion, from that dust carried by the air than from the water?—From the dust, I think.

17410. With regard to what happens after an explosion I gather you are of opinion that a wet zone of about 100 yards would prevent the expansion of it?—I think so; that is a proper zone, I mean free from dust.

17411. (*Mr. Ratcliffe Ellis.*) I am not sure; you mean a wet zone, effectively watered?—Yes, and I think a zone that is free from dust would prevent an explosion, if perfectly free.

17412. You could effectively water an ordinary road where you can water at all?—Yes.

17413. It would not be necessary?—No, it would be the same thing. If you could water a length of road for 100 yards effectually, roof, sides and bottom, that would be the same thing as preparing the place.

17414. (*Mr. Wm. Abraham.*) In a place where it is inconvenient to water effectively your main roads and haulage roads under ordinary conditions, would you then for the sake of prevention of an explosion that might happen, recommend the building of a wet zone here and there?—Most certainly it would prevent it spreading.

17415. You say under your management all men who are authorised to fire shots are bound every day to sign their names in a book, and give the number of shots to be fired, and the district in which they are to be fired?—Yes; I might say that that is more particularly at one colliery. It is not all the collieries; that is one colliery in particular where we considered it a drier mine than the others.

17416. Is there a rule compelling you to do that?—No, there is not a rule.

17417. You think that it is necessary as a precaution?—That is all.

17418. Then it would tend to the safety of the mine from shot-firing if a rule of that kind were compulsory in all dry and dusty mines?—Yes, it would, no doubt; of course, some people would consider that was more than necessary.

17419. In justice to careful managers of collieries, it is only right to admit that the law, as a rule, can do very little towards making those who are indifferent do what is done by those who are careful. You have found in your experience that it is expedient—and, indeed, necessary—to have that rule yourselves with a view to reducing the possibility of accidents?—Yes.

17420. Then a rule to that effect made general would have that effect?—There is no doubt it would.

17421. Then, to be brief, as things are in these collieries under your successful management, where you have had no explosions, and so forth, you find it necessary to have strict rules for the management and discipline of the colliery?—Yes, I have thought it was advisable.

17422. You have found it advisable to have precautions laid down to your men which are not provided for in either the General Rules or the Special Rules?—Yes.

17423. As a practical man, you would advise them that that should be the case in future?—Yes, I think it would probably be better for the prevention of accidents.

17424. (*Mr. Ratcliffe Ellis.*) Since you had this arrangement on the pit-top to prevent the dust going down the pit, have you found that the quantity down the pit has decreased much?—I have not measured it, but I think it is perceptibly better.

17425. Have you any method in force for a systematic removing of the dust?—No, we just sweep it and clean it up.

17426. Not at any interval, but when it is convenient?—When it is necessary.

17427. The necessity arises from the convenience of passing along it, and not with reference to an explosion, or anything of that sort?—Knowing myself that the dust is a very serious matter, I keep it down.

17428. What do you do with it?—We send it up to the surface.

17429. You refer to dry and dusty mines, and also you

Digitized by Google

Mr. S. Tate.

17 April 1907

refer to fiery mines. Have you any definition of a dry and dusty mine?—No, they are very nearly synonymous terms.

17430. If it is dry, it is dusty. Does one mine or one seam give off more dust than another?—Yes, depending on the nature of the coal, whether soft or hard coal.

17431. Which is the one that makes the most dust?—The soft coal.

17432. You have no experience as to whether these dusts are different so far as the danger is concerned?—Two explosions happened in the County of Durham, one Elemore and the other Wingate, and until these explosions happened I think we considered in both of these mines that the dust was not of a highly imflammable nature, We thought it was strong, hard coal, and not of an inflammable nature, I mean not highly inflammable; but I must say that we have received a shock to our ideas of security in those two explosions.

17433. That is a matter that wants scientifically inquiring into?—Certainly.

17434. You think it very desirable that there should be an inquiry into that?—It would be much better.

17435. You think there is a danger in sweeping up dust while shots are being fired in the mine?—I think you will see that.

17436. I quite see. This dust is brought into suspension by sweeping it up, which might take it in the direction of a shot, and the dust might cause mischief?—That is so.

17437. With reference to watering, do you agree with the German system, that there should be a compulsory system of watering?—It would not do for the County of Durham. I am certain it would close lots of mines if you had to water the roof and sides and floor.

17438. Would your view be that there should be an obligation on the manager to keep his mine, as far as possible, free from dust?—I agree to that extent.

17439. Leaving him to decide as to the best way to do that?—Yes.

17440. And then having done that, there should be an obligation to have zones, protected zones, at different parts of the pit, protected either by being watered, or by being sufficiently cleared of dust, again in the discretion of the management?—Yes.

17441. There may be cases in which you have neither one nor the other, where you could not water at all, where you could not keep up masonry because the depth is too great, or because of the creep, and where you could not clear an ordinary road of dust?—There are very few; I do not know of one at the present moment.

17442. There would have to be an exception for these cases?—Yes.

17443. Would you suggest any special precautions to be taken with regard to shot-firing in those mines?—Yes; if dust could not be cleared up and could not be watered, I would not fire shots.

17444. On the haulage roads?—On the haulage roads.

17445. You would have special precautions with regard to shot-firing in a case like that?—Yes.

17446. Where the powder is used, the collier fires his own shot?—Not in the deep mines where safety-lamps are used. It is only where candles are used that he fires his own shots.

17447. And with powder?—And with powder.

17448. When he fires his own shots, of course, he has a detonator and a cartridge?—A fuse.

17449. Where the collier fires his own shots, he does not fire with a detonator at all?—He has a fuse, the ordinary fuse.

17450. And he puts a light to the fuse?—Yes, what we call in the County of Durham a "kitty," which is a short piece of tube with gunpowder, almost like a boy's cracker. There is a little fuse attached to that, which he lights, and the flame flies into the powder.

17451. He is in possession of the whole of the material to fire the shot?—Everything.

17452. Where high explosives have to be used, that would not be allowed?—No.

17453. It is provided that where these high explosives are used every charge should be fired by a competent person, appointed in writing for this purpose by the owner, agent, or manager of the mine, and not being a person whose wage is dependent on the amount of material to be gotten?—Yes.

17454. Wherever high explosives have to be used, the collier would not be allowed to fire his shots at all?—No.

17455. He is the man to be paid by the quantity of mineral he gets?—By the collier it appears to me you mean the coal getter.

17456. That is so. The system appears to be with you that he takes the cartridge down with him?—Yes.

17457. Because it is his property?—Yes.

17458. It is what he has to use, like his pick or anything else to get his coal with?—Yes.

17459. The charging of the shot is one thing, but the firing is another?—Yes.

17460. He has the cartridge, but the material for firing it is in the hands of a competent person who is to fire the shot?—That is so.

17461. For the moment he hands the cartridge to the shot-firer to put into the hole, and at that moment the shot-firer has both cartridge and detonator?—Yes.

17462. Except in that way, always where high explosives are used, the explosive is in the hands of one person and the detonator is in the hands of the other?—That is only so far as the coal-getter is concerned. That is as regards the rippers and packers, the stone-men. He does stem his own shot.

17463. Whether the ripper and packer would be entitled to fire this shot would depend on the method of his payment. If his wages depended on the amount of material he got, he would not be entitled to fire the shot?—No. I must say there is a dispute between the inspectors and some managers in that matter. Some managers hold that as the material is not measured and weighed, the material gotten, that the stone-man is not dependent on the amount of mineral gotten.

17464. I was aware of that. What in your view should be the rule there? Should the stone-man fire the shots, or should he not?—The rule is, in my opinion, what I have adopted where high explosives are used. I have a special man to fire the shots.

17465. Whatever this rule means, it ought to mean wherever these high explosives are used the shot should be fired by some competent person other than the stone-man?—Whether it means that or not I think that is the proper principle to go upon.

17466. With reference to firedamp, you mentioned that you have read a Paper on that subject?—Afterdamp you mean.

17467. Yes, and then you say, "Briefly the suggestion put forward in my paper was to seal off by means of doors all portions of the mine which the blast of the explosion had not penetrated to secure the uncontaminated air in any particular district and keep out the deadly afterdamp which claims so many lives"?—There should be the words added "where men are situate."

17468. Would you shortly explain to the Commission how you do this? Are the doors put there to begin with, or do they have to be taken there?—My idea was this. In all districts where there was a natural position (or if not a natural position, make such a position) there would be only a certain limited number of roads, that is passage-ways, that is the main haulage roads and the return, say, one on each side, or if there was a travelling way, not more than four. At those places erect door-frames, and the doors could be placed by the side, and in the case of an explosion the men who were in there, as soon as they came to this point and found that there was an explosion in the pit would immediately close those doors and remain within them.

17469. Are the doors to be lying on the ground at the side?—They would be standing at the side; they would be all right.

17470. What do you suppose they would be made of?—Ordinary wooden doors, the same as the ordinary mine doors in the pit.

17471. For that system you would want a special method of working the mine. You could not apply it to an ordinary mine?—I think in that Paper the diagram shows both the longwall, the board and pillar, and the pillar and stall.

17472. You think that might be the means of preventing the afterdamp from going into the districts of the mine?—Yes, the only drawback to it is this: if you could get the men to do it. I am certain if they would do it, it would be successful.

17473. What prevents them doing it?—The desire to get out of danger, that is all.

Digitized by Google

17474. Supposing that was a practicable suggestion, it would be of the greatest possible use if you could have rescue apparatus in which a man could feel confident that he was going into this damp which would be otherwise fatal, and be quite safe?—They might go in and close these doors, and keep the men there until the ventilation was restored.

17475. They would be useful for that purpose?—Yes.

17476. It would be necessary for somebody to have to go to a certain amount of danger to shut the doors?—In the in-bye side, if the afterdamp had reached the doors, they could not be saved.

17477. Why could they not be saved?—Because the afterdamp would kill them.

17478. If you had an apparatus in which you could put the doors up without being affected by the afterdamp, would that not do?—For the men that are inside?

17479. I mean for the men who are going to put the doors up?—That would have to be an apparatus that was in the mine always.

17480. You could send men through the damp and put them on the safe side of it, and let them put the doors up?—I am afraid, if it was unsafe for the men to come up and put them up themselves, the afterdamp would be in front.

17481. One has the apparatus which enables him to go into places which men could not without?—I have known several cases in the mine. I know one case in particular, where a man got between two ordinary ventilation doors and he made those doors as tight as he could and he lived certainly a day or two, some said more. He left records in chalk.

17482. These are men who have no protection whatever. These men are in no way protected against the effects of the gas?—No.

17483. Supposing they had a rescue apparatus, they could do a great deal that could not otherwise be done?—I question whether you would get men to use it. You would have to educate every man in the mine.

17484. Does that not point to the necessity for training them in the use of these? The men must have confidence in them?—A man must have some experience in them. I saw them use it at one time, but men lose confidence when shut off from the ordinary atmosphere sometimes.

17485. Have you seen a station where the men are trained?—Yes.

17486. Do you not think it a great advantage that the men should be trained and given confidence to show that they can safely go into gas?—Under certain conditions it would be advantageous, certainly.

17487. Do you see any condition in which it would not be advantageous that a man should be trained, and should feel that he could go into most dangerous gases with perfect safety?—It is hardly practicable to train all the men in the colliery.

17488. If you have a few trained men it is better than none at all?—Yes.

17489. In your experience do you think that the blast and the flame go together, or that one precedes the other?—There is a force which precedes the flame.

17490. Do you think the force precedes the flame?—Some of the force.

17491. It has been suggested that the flame precedes the force, and the flame may pass a point before the blast puts the dust into suspension?—It would die out.

17492. Do you agree with that?—I think it would die out.

17493. You think the blast goes out, puts the dust in suspension and then the flame comes?—I am certain that is the case for this reason: men often have experienced some amount of blast and never see the flame at all—I mean the men who are saved. It is what they call a waft of wind, and they never see the flame.

(*Chairman.*) I rather thought that one of the witnesses meant that as a general rule the blast preceded the flame where you have an obstacle such as a door which is broken down by the blast, and that the blast is stopped momentarily, and that the flame goes through and gets in front.

17494. (*Mr. Ratcliffe Ellis.*) Do you think there could be any contrivance adopted by which you could contrive that the flame went before the blast?—I think not. I think that is impossible.

17495. You think nothing can be done in that direction?—No

17496. (*Sir Lindsay Wood.*) The same formation of the flame causes expansion of the atmosphere?—Yes.

17497. (*Mr. Ratcliffe Ellis.*) With reference to shot-firing, you have explained in what particulars you think that the present Rules might be improved. Do you think that it would be desirable that there should be a specific interval prescribed between the firing of shots?—No, I do not think it is necessary so long as a person goes back and sees the other shots are all right. That is according to our Special Rules. A man every time he fires a shot must go back and examine the place.

17498. You think that is sufficient?—That is ample.

17499. (*Chairman.*) Surely sometimes there may be a miss-fire and it does not go off for a quarter of an hour?—That would not be the same difficulty.

17500. (*Mr. Ratcliffe Ellis.*) I mean, you must have an interval between the firing of one shot and the firing of a second shot?—That is not the same as his Lordship speaks of. He says a miss-fire and you say a fire, I take it.

17501. (*Chairman.*) Supposing you fire several shots at the same time and one shot misses fire, ought you to be able to come back again after that missed shot at once and take it away or do something with it, or ought it to be necessary that a certain amount of time should elapse before you go near the miss-fire shot?—In ordinary mining we only allow one shot to be fired at once.

17502. Supposing it is a miss-fire?—Then he does not go back until sufficient time has elapsed.

17503. (*Mr. Ratcliffe Ellis.*) When you say you only allow one shot to be fired at once is that because of the rule that an examination should be made after each shot?—That is sufficient.

17504. You imply from that rule that it means that?—I think it means that.

17505. (*Chairman.*) You mean you cannot have several charges put in at once and fired at the same time?—We would not allow that.

(*Chairman.*) It is not illegal putting in a lot of shots at the same time.

17506. (*Mr. Ratcliffe Ellis.*) You consider the meaning of the rule that the examination should be made after the firing of each shot that there should be one shot fired at a time?—That is what it means. That is what I take the meaning of it to be. I think it is the commonsense meaning of it.

17507. (*Chairman.*) It ought to be expressed better. You must not fire more than one shot at a time?—In sinking pits it is rather different. They do fire a series of shots.

17508. (*Mr. Smillie.*) In ripping, too?—Yes.

17509. (*Chairman.*) As to ripping——?—We only fire one in ripping. In stone drift work, that is in driving in the solid rock, we fire two or three shots together, but that is the same in a sinking pit.

17510. Is that an infringement of the rule?—I think not.

17511. (*Mr. Ratcliffe Ellis.*) Where do you get your authority for that?—I know it is done.

17512. It is the same rule?—Yes.

17513. (*Chairman.*) It is desirable that the rule should be made clear. It should be certainly allowable or not allowable to fire a shot at any time or under any circumstances?—Probably it would be better.

17514. (*Mr. Smillie.*) You are a firm believer in dust explosions?—I am, and have been for many years.

17515. Wingate explosion has convinced you more than ever?—Yes, if I have required it.

17516. It has convinced you and other people that even dust in Durham has exploded, and that it is highly inflammable?—Yes.

17517. Is it your opinion that to initiate or continue an explosion dust must be in suspension?—I am not quite sure, because I think if the blast penetrates into the dust and sets it up, that is sufficient to send it away.

17518. Supposing we have a main haulage road in which there was dust on the roof and on the sides and the bottom but really none in suspension, and a shot was fired, do you think that would cause a dust explosion?—I am sure it would, like a blown-out shot—not all of the shots, but some would.

17519. Some witnesses before the Commission were of

Digitized by Google

Mr. S. Tate.

17 April 1907

opinion that dust must be in suspension before it would explode. In the case of Wingate there was only one shot fired?—That is all.

17520. That shot must have raised the dust and at the same time fired the dust?—Yes. May I state an experiment I made in which I illustrate that? When testing permitted explosives I put the permitted explosive on the ground and covered it with dust, fine coal dust, and I fired the charge, and I had two distinct detonations, one of the shot, and immediately afterwards the one in the dust and that is what takes place in the main haulage roads.

17521. It has been stated here that coal-dust explosions which are caused by shot-firing usually take place when a second shot is fired, and immediately after the first shot has been fired and raised. They put the dust in suspension, and the second shot causes the explosion. That would not be the case at Wingate?—I know four separate heavy explosions where only one shot was fired. I could give the names if necessary.

17522. Have you ever considered the question of the reversing of the air current in a mine when an explosion has taken place in an intake aircourse?—Yes, it would do very little good, I think, because the intake and the return are, as a rule, in a heavy explosion made common through the blowing out of doors, crossings and stoppings. Both are common to the afterdamp.

17523. Supposing it was possible at Wingate to have reversed your air current, it would not have taken the afterdamp out of that mine where that shot was fired; providing your downcast shaft and your fan were all right you could have reversed your air current. Would that not have taken the afterdamp out, and the men would have come safely out?—No, the communication between the return and the intake was destroyed, that is to say, the separation between the intake and the return.

17524. Could that not have been repaired in a very short time?—It was right close to the scene of the explosion.

17525. It was at the bottom of the pit?—The explosion occurred *here* (*indicating on Plan*). These stoppings *here* were all blown out. They were blown through.

17526. *That* is your intake aircourse. Supposing that was made the return for the time being by reversing the air current, would that not have drawn the afterdamp?—No, it was *here*, too. The whole place was filled with afterdamp *here*. *This* crossing was blown out, and the air came through *there*.

17527. Can you conceive any advantage it would be to have a fan to reverse the current without stopping your fan?—No, I cannot. It would not do any good.

17528. Supposing it were possible?—Supposing it were possible, it would do no good.

17529. You do not know any case in which it would do good?—I have not seen a case where it could do good, because the returns and intakes are filled with afterdamp.

17530. Supposing a fire takes place in the bottom of your downcast shaft?—An ordinary conflagration?

17531. Yes. Would it be an advantage to reverse it?—Yes.

17532. That would be a case where it might be?—Yes, that would be.

17533. In very deep mines, where the temperature is very high and very dry and dusty, would not the watering tend to reduce the temperature?—Yes, if the water is put on at a lower temperature than the atmosphere.

17534. It would tend to reduce the temperature, although it might be more uncomfortable and oppressive for the men; but that might be neutralised by lowering the temperature?—Yes, provided it did not get into the form of steam.

17535. Quite?—Of course.

17536. You would have to go a long way down to turn it into steam. Do you agree with Mr. Carnes in long-wall working that you must be three-quarters of a mile in-bye before you cease to feel the effects of crush?—The effect of long-wall ceases long before you get that far back from the face.

17537. In general cases in deep mines would I be right in saying that at 300 or 400 yards the crush is almost passed by?—We endeavour to keep our landings within 200 yards, because we think that the effect is practically passed.

17538. The crush is fairly well settled down?—Yes.

17539. So that if it is settled when you are 300 or 400 yards in-bye, it would be possible, if you were not working another seam under it immediately afterwards, to build masonry there?—Certainly within 400 yards of the face I think it would be possible to get masonry to stand.

17540. It is not too much to say that watering would close many of the collieries in Durham, if watering were made compulsory?—I think it is not too much to say that; from my experience of some of the roofs, it would close them. I mean close the roadways.

17541. I beg your pardon; I understood you to mean the colliery would have to be closed up?—It would close the roadways, and the expense would be so great to maintain them I think it would almost make them profitless.

17542. During the past 50 years there have been many prophecies of that kind which have not been realised. It has been said if certain things were done, such as taking children out of the mines, even in the collieries of Durham, that they could not be carried on. That has not taken place?—I can only speak for that one case, of the mine where I watered the roads, and it was a splendid haulage road to commence with, and when we put the water on we could scarcely keep it until we had ceased. It was not for some time that I discovered the cause.

17543. I shall be correct in saying the mining industry in Great Britain has gone up by leaps and bounds during the last 50 years, in spite of legislation?—Yes.

17544. Legislation has not ruined the mining industry up to the present time?—No.

17545. I am anxious about these doors. Would your doors, as shown in *this* Plan, be erected really in your main air-course?—The frames are.

17546. The doors are supposed to be put on if the men have sufficient confidence; the men are supposed to hang on the doors, and make them air-tight, and keep the air pure for the time being?—On the in-bye side.

(*The Witness explained to Mr. Smillie on the Plan with regard to the position of the doors.*)

17547. The men, who are putting those doors for their own protection before they finally close them, open up two doors outside, which form an air-course outside of the doors that they close?—That is so.

Digitized by Google

TWENTY-SEVENTH DAY.

Thursday, 18th April, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
H. H. S. CUNYNGHAME, Esq., C.B.
WM. ABRAHAM, Esq., M.P. (Rhondda).
THOMAS RATCLIFFE ELLIS, Esq.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. JAMES TENNANT FORGIE, called and examined.

Mr. J. T. Forgie.

18 April 1907

STATEMENT OF WITNESS.

17548. I am a civil and mining engineer, and have a certificate as a manager under the Coal Mines Regulation Act. I have had 36 years' experience of coal and ironstone mines, and have been manager of mines in Lanarkshire, Ayrshire, Stirlingshire, Dumbartonshire and Linlithgowshire for 33 years. I am presently a partner and director of the firm of Wm. Baird and Co., Limited., iron and coalmasters, and have charge of the Lanarkshire, Stirlingshire, Dumbartonshire and Linlithgowshire Coal and Ironstone Mines belonging to that firm. These mines have an annual output of over 1,700,000 tons. My firm at the present moment is producing at the rate of over 3,250,000 tons of coal per annum.

I was for three years President of the Scottish section of the Institution of Mining Engineers. I am here as representing the Scottish Coal Owners.

(1) The colliery owners, agents and managers of Scotland have for some years recognised the dangers of large accumulations in the mines of dust of an explosive character, and the part which such dust has undoubtedly played in some of the disastrous explosions which have occurred in coal mines from time to time.

(2) They also recognise the necessity there is for the adoption of some special means whereby, when a small explosion of gas, or a blown-out shot, especially of gunpowder, does take place, this initial explosive force will be stayed in its course, and be prevented from extending over a larger area with disastrous results.

(3) If the accumulations of explosive dust are either removed or treated in some way to make them non-explosive, then you at once take away that factor which has in the past caused some explosions in mines to be spread over a great area and to be so fatal in their results.

(4) In Scotland we have had few large explosions during my experience. Only in one, viz., the Blantyre explosion of 1878, did the loss of life exceed 100; the deaths on that occasion were over 200. A few months afterwards at the same colliery a second explosion resulted in over 20 deaths. The year following, an explosion occurred at Barwood Colliery, Kilsyth, resulting in 17 deaths. In Udston Colliery, about 1885, an explosion resulted in over 60 deaths, and in Quarter Colliery, at Denny, about 10 years later, another explosion resulted in 13 deaths. The Blantyre and Udston Colliery disasters are now supposed to have been due to dust. Dust played no part, I think, in the Barwood Colliery explosion, and it is doubtful if the Denny explosion was, to any great extent, due to dust as, if it were, I would have expected much more disastrous results than what occurred. At all events, the dust did not seem to be of a quality sufficient to carry the explosion very far. Excepting Barwood, these explosions all took place in safety-lamp pits.

(5) Scotland has been spoken of before this Commission very unfavourably with regard to explosions, and I would like to say something of this.

(6) With the exception of the large and deep collieries in and around the Hamilton, Blantyre and Bothwell Coalfield, the coking coal pits in the Kilsyth and Kirkintilloch districts, a few collieries in Fife, and an odd pit here and there, all the other pits in Scotland are worked with open lights.

(7) All the open-light pits are not free from fire-damp, and it does happen now and again that a little fire-damp collects in some hole in the roof or in the face of the brushing in Longwall working. This may inadvertently be kindled, and what is called an explosion occurs, and loss of life or injury may result. In 1905, according to Mr. Delevingne's tables produced before this Commission, only two were fatal, and 67 were non-fatal, injuring 93 persons. A large number of these 93 persons are only very slightly injured, but by Section 35 of the Coal Mines Act, 1887, all accidents from explosions of gas causing injury to person must be reported to the Inspector of Mines. A great many of these so-called explosions are not really explosions at all, but simply ignitions of gas slightly scorching a man who may only be off his work for a day or so. These explosions and ignitions of gas occurring in the open light pits of Scotland, with comparatively small results, so far as loss of life and injury to person are concerned, prove very conclusively that at least in these pits there is little to be feared from dust, and I think in Scottish pits generally, with a few exceptions, the danger from dust is not serious.

(8) Most of the pits are more or less naturally damp, and the tubs for conveying the coal from the face to the pit bottom have all close bottoms, sides and ends.

(9) Since 1885 we have had no serious explosion in which dust played a part except at Quarter Colliery, Denny, and that explosion extended over but a small area of the working. We have a number of small explosions and ignitions of firedamp, which is of course to be regretted, but it is a question for serious consideration whether by the introduction of safety lamps, where open lights are now used, any advantage would ensue, as I have no doubt the accidents from other causes, such as falls and haulage accidents, would be increased with the introduction of safety lamps. In most of the pits using safety lamps the seams are flat, whereas in those using open lights the seams are in a great many cases steep, and safety lamps would be a great disadvantage, and would lead to an increased number of accidents from falls of roof and sides and haulage.

(10) Deaths from falls of ground and haulage in Scotland were, during the five years ending 1905, 13 times more numerous than those from explosions, and the deaths from falls and haulage in the United Kingdom for 10 years to 1905 were 6,621, and from explosions, 720, showing the deaths from falls and haulage to be nine times more numerous than the deaths from explosions. The figures above include deaths from explosions in which dust has participated.

(11) In considering what should or could be done to reduce the danger from dust, one of the first things to be ascertained is the quality and quantity of dust necessary to cause or extend an explosion. In Mr. Hall's experiments, which were necessarily of a

Digitized by Google

Mr. J. T. Forgie.

18 April 1907

very crude kind, a large number of dusts were tested. Some were found to be of a very explosive character, others less so, and others again were found to be non-explosive. Some of the dusts were analysed, and their explosive force in some cases bore a certain relation to the analysis.

(12) I would suggest that a Government Department should take charge of this matter, and at once appoint a committee of experts, consisting of scientific men, inspectors of mines, mining engineers, and representatives of the coalowners and managers, to make exhaustive inquiry on the subject, and to carry out a series of experiments and tests on as large a scale as is practically possible in order to determine the character and quality of different dusts, which make them explosive or non-explosive.

(13) Analysis does not altogether determine this, as in some cases Mr. Hall had very violent explosions with dusts, having a very high percentage of ash, while in some of the dusts which he could not explode, there may have been a low percentage of ash. The quality of the ash and its specific gravity, and whether all of it, or a portion of it is chemically combined with the coal, or is only mechanically mixed with the coal, and the percentage of combined water in the coal, may all have some bearing upon its being explosive or non-explosive, and this can only be arrived at definitely by a series of such tests and experiments as I have suggested.

(14) At present, especially in the mines of Scotland, there are differences of opinion between the management and the inspectors as to what is dangerous dust. In one of our collieries some years ago, the inspector of mines called on us to water the dust at the faces in a certain section before firing shots. We were strongly of opinion that the dust at these faces was not of a degree of fineness nor quality to make it in any way dangerous. The inspector consulted the Home Secretary, and asked to have the question settled by arbitration. In the meantime we asked Mr. Galloway from South Wales, an expert on the dust question, to visit the colliery. He did so, and made a minute and careful investigation, and in his Report stated the dust was not dangerous, and that there was no necessity to water it, but that as the section was small and the watering in this case would not entail much expense, and would not damage the sides and roofs, and to save arbitration, he would recommend us to fall in with the inspector's request. We have in no Scottish mine, I think, dust such as there is in the Welsh and some of the English mines.

(15) In a case of difference of opinion such as I have mentioned, a dust expert could be sent down by the Committee to make a special investigation, and if he found the dust in his opinion likely to be of a dangerous quality and quantity, he could ask for temporary watering to be done, and at the same time take a fair average sample of the dust with him to be thoroughly tested on a large scale and reported on. That Report would determine whether the place were dusty or not to a dangerous extent.

(16) A searching investigation should also be made by this Commission as to the true cause of dust explosions, and they would then be in a position to determine the remedies which would be required to prevent them in the future.

(17) Universal watering has been suggested, but there are very strong objections to this. In some collieries it would be practically impossible, and, if enforced, would be the means of shutting them down.

(18) The abolition of shot-firing is also out of the question. Many mines could not be carried on if this were enforced. Especially in stone work is shot-firing absolutely necessary, and in some seams the getting of the coal would be much increased in cost and reduced in value if shot-firing were prohibited. Shot-firing in stone work and in main haulage roads might, without very serious disadvantage, be carried out at night or when there were few men in the pit, but it would be extremely difficult and expensive and almost impossible to arrange for shot-firing in the coal to be done in the same way, and especially in machine-worked coal. Besides, there is no doubt that the danger from coal dust at the face is small as compared with what it is in main haulage roads, and there is therefore not the same necessity for prohibiting shot-firing in the coal during the ordinary shift.

(19) To ensure increased safety in a dry and dusty main haulage road, it might be made a rule that the firing of every shot in such main haulage road should be brought specially before the notice of the manager or overman in charge of the colliery, and special authority be given by him to the shot-firer to fire the shot, and without which authority the shot should not be fired.

(20) Much of the dust in the main haulage road might be prevented from collecting by having closed hutches, and much that collects might be removed from time to time, but it would be extremely difficult and almost impracticable to have it all removed, and therefore where dust of an explosive character and quantity is known to exist, some precautions must be observed when there is also a possibility of gas being present and being ignited, and there is shot-firing.

(21) We are of opinion that in Scotland, with possibly one or two exceptions, the General Rules of the Coal Mines Act, 1887, and the Explosives Order of 1906 applicable to coal dust are quite sufficient, and that in any future legislation dealing with the subject, if any more stringent rules and regulations are made, such mines as I have referred to should be exempted.

(22) In dry mines having explosive dust which, from the nature of the roof, floor and sides it would be impossible to water throughout and from which it would be impracticable to entirely remove the dust, a system of watered or dust-free zones would probably prevent the explosion from extending from one section of a mine to the other. If these zones could not be watered, then it might be necessary to have them arched with brickwork, or the sides so prepared that the dust could be easily removed from time to time. I can easily see that in collieries where there are several seams to work, the working of a seam under or over a zone in another seam would so affect and disturb a prepared zone as to make it difficult to properly clear all the dust out of the zone. It would be necessary for the Commission, after having the dust tested, to determine the length of zones required and where they should be placed. Different dusts would probably require different lengths of zones according to their explosive character.

(23) Regarding coal dust from the screens being carried down the downcast shaft and into the main haulage roads, I am of opinion there is no great danger to be apprehended from this cause, especially in Scotland where the shafts are generally wet. The dust would get damp and would settle on the sides of the shaft or on ledges and remain damp, or find its way into the sump and be pumped up with the water, or have to be cleared out of the sump in the form of slurry from time to time. In any case I think it would not be carried by the air current far from the pit bottom and would not be a serious source of danger. Besides, in modern collieries, the tendency is to have the screens in a separate house and much farther from the pit mouth than used to be the case, and the likelihood of dust being carried down the shaft is therefore much lessened.

17549. (*Chairman.*) Have you had any experience outside Scotland?—None, further than visitations of mines.

17550. You come here as representing the Scottish Coal Owners?—I should have said that I come in company with Mr. Mowat.

17551. You say that you have long recognised the danger of large accumulations in mines of dust of an explosive character. You have recognised it for a long time, but do you think that the ordinary working collier has recognised it?—I do not think so.

17552. Do you think he is recognising it now?—To a very great extent he does not recognise it.

17553. Are you taking any means to induce him to pay attention to the subject of explosions caused solely by coal dust, without gas?—We have no great necessity to do so in Scotland, as I state in my evidence. So far as we as a firm are concerned, we have only one colliery in which there is any great danger from dust, and we had a serious explosion at that colliery ten years ago.

17554. So that you have one colliery where there has been a serious explosion?—Yes.

17555. What did you do with regard to that colliery?—That colliery does not come under my charge, but I happened to go there after the explosion occurred ten years ago; that is the Denny explosion, to which I refer in paragraph (4) of my Statement, causing the loss of thirteen lives.

17556. In your opinion the Denny explosion was not

Digitized by Google

due to any great extent to dust; it was not much carried on by coal dust; if it had been, there would have been a much greater loss of life?—Yes. There were a great number of men in that pit and there was a large quantity of dust; the dust did not seem to feed the explosion, because it was undoubtedly an explosion from a shot kindling gas at a certain point. I daresay the extent of the explosion was made greater by the dust, but the dust seemed not to be sufficient to carry the explosion to any great extent, because there was a long road in which there were about six inches of very fine dust lying in the bottom at the time of the explosion, and when the explosion came to that spot it crossed a wet dip haulage road and knocked the brattice walls down, and the flame evidently travelled along the top of the dust in that road for a distance of about 250 or 300 fathoms; there was evidently no force in it, but it just raised sufficient dust to carry the flame until it got to the end where it kindled the brattice cloth, and several hours after, when the exploration party went through the part where the explosion was, we discovered this place on fire, but no signs of force. So that the dust in that case, even where it was very fine, was not of a very explosive character. Although in Mr. Hall's experiments the dust showed violent explosions in the shaft, actually in practice in that mine it seemed to me that it was not sufficient to carry on the violent nature of the explosion, but that ultimately it died out.

17557. You say there was a great deal of very fine dust, which Mr. Hall found to be explosive dust, in a road in that explosion; but do you think that that dust was in the atmosphere? Was it not probably lying on the roadways and on the roof and sides?—The great bulk of the dust was lying on the roadway; it was an unused road.

17558. Therefore, there was very little dust in the air?—There would be no dust in the air previous to the explosion.

17559. We have had evidence given by one Witness as to a reason which perhaps might account for the explosion not being carried on by the coal dust, or only carried on to a very small extent under those circumstances, because you say that the force of the explosion was stopped by a door, which was blown down?—That would reduce the force of the explosion to a great extent.

17560. The suggestion has been made to us that where anything of that sort occurs, and where the explosion is stopped or partially stopped by a door that is blown out, the flame goes in front of the explosion instead of behind it, and the consequence is that there is no wind to blow up the dust until the flame has got past. That is the suggestion which has been made to us?—I should think that immediately the door was blown down, the explosion would drive whatever air was lying in that place before it, and that would raise the dust. There is bound to be air lying in that place, and the gas or burning flame coming into it is bound to disturb it, and that would naturally raise the dust.

17561. Would the flame move the air unless there was wind carrying it?—I should think it would. There must have been some little force when it broke down the door. I do not think it would expend all of its force in breaking down the door.

17562. It has been suggested to us that the force of the explosion is to a very great degree expended in blowing down the door; the consequence is that when the door is blown down the flame naturally finds nothing to prevent it going on, and it goes on at a great pace in front of the blast, so that at the time the blast comes to stir up the dust there is no flame left to explode it. That has been the theory placed before us?—I should not think, considering the nature of this dust, that the flame would travel very far unless it were fed.

17563. No; but my point is that where you get such a state of things as this, that a flame goes through a dusty part of the mine without being accompanied by any blast, or being only accompanied by a very small blast and not a sufficient blast to kick up the dust, in that case it may very well be that, although there is a great deal of explosive dust lying about which would have fed the explosion had there been a blast with the flame, yet where there is no blast with the flame the flame may go on harmlessly through that dusty part of the mine. That is what has been suggested to us?—But for the flame to go on it must have been fed by something, because unless the flame were fed it would go out altogether.

17564. It probably did go out?—No, it did not go out, because it kindled the brattice at the other end of this road.

17565. So that, according to your theory, there must have been just enough dust raised to feed the flame?—Just enough dust raised to feed the flame.

17566. A certain amount, but not enough to cause the explosion to go on with any violence?—No; and the dust was of such a nature that it would not carry the explosion very far.

17567. I understood you to suggest that Mr. Hall analysed the dust and found it was very explosive?—That is so; but the dust in that case was taken from the screens of the colliery, where there would be very pure dust, and it would be very different from the dust that actually lies in the mine. I do not know the analysis of the dust, because it is not given in Mr. Hall's paper.

17568. Then Mr. Hall did not analyse this particular dust through which the flame passed without carrying on the explosion to any great extent?—No.

17569. So that your theory is that the explosion was stopped, not so much because the flame went on in front of the blast, but because the dust in this particular part of the mine was so much mixed up with harmless dust?—That is my opinion.

17570. You say that nearly the whole of the coal mines in Scotland, with few exceptions, are worked with open lights, and yet that you have small explosions constantly going on?—That is so.

17571. You have small explosions occurring pretty often?—Of course, as I mention in my Report, they are not really explosions; a great number of them are not explosions, but are simply ignitions of firedamp.

17572. Ignitions which do a certain amount of harm?—Sometimes they do harm; at other times they do not.

17573. In 1905, according to the statistics furnished to the Commission, there were two fatal accidents and 67 non-fatal accidents, there being 93 persons injured. That is a considerable number?—Yes, but it is a very much smaller number than are injured by falls of roof and sides.

17575. I quite understand that. I see from the statistics that Scotland has rather a bad reputation in the matter of accidents from explosions, both as regards deaths and as regards non-fatal accidents. Do you not consider that the use of naked lights has a good deal to do with that?—I am not prepared to admit that. I have looked over the statistics and they do not to my mind bear out that Scotland has a bad reputation. I do not suppose that it is the best district in the country; that is a matter which I did not go into; I simply brought out a comparison between the number of men injured and killed by explosions, because I meant to go into those figures in my general examination.

17576. Our business is to see that nobody is injured if we can possibly prevent it, and it is hardly an answer, when we see that a certain number of accidents are caused probably by naked lights, to say that a much larger number of accidents are caused in some other way?—I admit that in a way, but of course in another way it has to do with the question, because if you introduce close lamps as against open lights, we contend that, especially in Scotland, there would be more accidents from falls of roof and sides.

17577. I know that that is the contention, but what do you proceed upon when you say that; why do you say there would be more falls of roof and sides?—Mr. Mowat can speak to that and can give an illustration from actual figures within his own experience.

17578. Then you proceed upon what you have heard from other people?—From my own experience in a general way.

17579. What is your experience?—Our own experience is that in steep workings (and there are a great number of steep workings in Scotland, and especially the workings where the open lights are at present used) those workings would be very much more dangerous if they were worked with safety lamps, because a man's light would be oftener going out and it would be a very great danger for him to be landed in a steep incline with his light out, and to have to travel down that incline in the dark. There are other ways also in which it would be more dangerous to use safety lamps than open lights; there can be no question as to what Scottish people think with regard to that matter, especially in steep workings. I admit that in flat workings there is not very much in it, but in steep workings it would certainly be a very great drawback to have safety-lamps instead of open lights.

Digitized by Google

Mr. J. T. Forgie.

18 April 1907

17580. Is that so: is there very much more likelihood of a safety-lamp going out than of a naked light going out?—The difficulty is in re-lighting it. A man can carry matches when he has an open light and can light his lamp, whereas with his safety lamp he must go to a lighting station in the dark, or he must wait where he is until some other person comes to light it for him or to bring another lamp.

17581. That man might be left in the dark, and that would be disagreeable no doubt, and would interrupt his work, but in what way would it be dangerous?—If he were walking up an incline down which traffic were going he might be run over.

17582. How about the tubs; are they not lighted?—No; in self-acting inclines there are no lights; the loaded tubs going down pull up the empties.

17583. And there are no lights either on the empties or on the others?—No.

17584. Might it not be desirable that there should be some rule made that there should be lights?—I do not know that even a light would save him.

17585. He would be able to see it, at any rate?—He would see the light coming, but he might not know where to go to.

17586. He might or he might not?—He might or he might not. It would reduce the danger to a very small extent; but we have never considered that matter.

17587. I thought it might be worth while considering it. You go on to say in your statement that in considering what would or could be done to reduce the danger from dust, one of the first things to be ascertained is the quality and quantity of dust necessary to cause or extend an explosion. Then you allude to Mr. Hall's experiments and you suggest that also inquiry should be made into the subject. Have you anything to say from your own experience as to the proportion of coal dust that would be dangerous in the way of carrying on an explosion?—No; I think that can only be determined by experiment.

17588. Some witnesses have told us this: that a very dense cloud of coal dust may be not so explosive as a less dense cloud. I do not know whether you have gone into that at all?—No. I could understand that it might be the case, but I am not sufficient of a chemist to deal with that point.

17589. You say that in a particular case Mr. Galloway went into the matter and that he declared that coal dust was not dangerous. Was that because there was not enough coal dust in the mine, or because of the nature of the coal dust?—It was because of the quality of the coal dust, to start with. It was not very fine dust; he did not analyse it, but looking at it it was quite easily seen that it contained a great deal of foreign matter, and then he said there was not nearly sufficient dust, and that it was not dry enough. He declared most distinctly that there was not the slightest danger from dust in that place.

17590. You object to universal watering, and you say that in some collieries it would be practically impossible, and if enforced it would cause a lot of mines to be shut down. Do you mean on account of expense?—Yes.

17591. Also, do you think that there might be more danger from falls of roof and sides if there was universal watering? There might be a little, I do not know that there would be a great deal, in the question of danger.

17592. Not in Scotland?—No. I am referring, of course, only to Scotland. But certainly in Scotland watering would do a great deal of harm in many collieries.

17593. In what way?—In the way of closing roads because of heaving, and so on. I do not know that it would very much increase the danger to persons; there would be rather more gradual closing of roads, heaving of pavement, and swelling of material.

17594. So that you do not object to universal watering because of the danger that it would cause to miners, but because of the great expense which would make you shut down some of your mines?—Yes.

17595. With regard to shot-firing in stone work and in main haulage roads you say it might be carried out at night. Then you do not have night-shifts?—Yes, in Scotland we have night-shifts in the longwall pits. We have not night-shifts of colliers; there is no coal hewing at night, but we have night shifts of stone-men.

17596. So that you suggest that where the firing is in the main haulage roads or in stone work, it should be carried out at night, when there are comparatively few people in the pit?—Yes, when there is a necessity for it because of dust. But if the road is not dusty I do not see that there is any necessity for the shot-firing being limited to night work.

17597. Then you would have some sort of rule put in force to the effect that in dry and dusty mines wherever there was firing in stone work in the main haulage roads it should, where reasonably possible, be carried out at night?—Yes.

17598. You think that would be a proper rule to make?—I think so. Of course I wish to point out this, that I am referring to stone work in the waste, that is to say, in the roads that have already been driven in the coal. In a fast-stone mine I do not think that rule should apply, because a fast-stone mine would require to be driven night and day and shots fired continually every two or three hours, and there would be no danger of coal dust there.

17599. And there, where in order to work the mine satisfactorily, you have to fire shots every two or three hours, it would very seriously handicap the working of the coal to insist upon shot-firing being carried out only at night?—I think it would be impossible in a great many cases.

17600. Even in the main haulage roads I suppose there are very few shots fired, are there?—Comparatively they are few, and they can be quite well fired at night.

17601. Then you would not object to some sort of rule which would provide that where reasonably possible, at all events in main haulage roads, no shots should be fired except at night?—I quite agree with a new rule of that sort; and also to make provision for special firing of the shots. I think I mention that in my statement. I say that to ensure increased safety in a dry and dusty main haulage road, it might be made a rule that the firing of every shot in such main haulage road should be brought specially before the notice of the manager or overman in charge of the colliery, and special authority be given by him to the shot-firer to fire the shot.

17602. I think nearly everybody agrees with that, and I understand that in Lancashire they have rules to that effect, and it is generally the practice in other coalfields. Perhaps you would say that it would be just as well that that practice should be enforced by rule?—Yes, I think so.

17603. And possibly that might be made a rule which should be made a General Rule?—Yes.

17604. You go next to the question of removing the dust in the main haulage road by having closed hutches. What do you mean by "closed hutches"?—The tubs. We call them hutches in Scotland.

17605. That is to say you fill the tubs, close the tops of them, and then haul them out?—No, we do not close the top, but the four sides are closed.

17606. Does not the dust then blow out?—No, not particularly.

17607. Do you simply put the dust in dry?—We put the coal in dry as we get it at the face. Of course there is not much of our coal that is what you could term dusty coal; we have not such quantities of dust in Scotland that there are in some of the mines in England and Wales.

17608. Then you do not mean that the dust of the main haulage roads might be prevented from collecting by the use of closed hutches. When you speak about "dust" you mean coal, in that instance?—Yes, when it gets ground into dust by men and horses and gets broken up or disintegrated by the wet.

17609. What you mean is that you ought to have tubs which are closed on all four sides?—Tubs which are closed on all four sides: we have them in Scotland. Of course in some very few cases we have doors at the one end which close; but they are fairly tight.

17610. Are you careful to see that the hutches are kept in repair so that the coal dust will not sift out?—Yes; we keep repairers constantly doing the repairs; it is to our interest to do that to save loss of coal.

17611. Do you think it might be advisable to have some sort of general regulation to the effect that those hutches should be kept in good repair, because if they are not they would seem to be a source of considerable danger by scattering coal dust all over the mine?—Yes, I think there would be no harm in that; but, of course, stipulating for everything of that sort leaves little to the management. I think it is to the interest of the management to keep the hutches in repair.

17612. Yes, but you see some management is better than others, and you might have a careless manager or a manager who wanted to save a few pounds by not repairing the tubs when they ought to be repaired?—

Digitized by Google

I should be inclined to limit a rule of that sort to mines which are dry and dusty or likely to be dry and dusty.

17613. Then how would you propose to remove the dust except by watering. In some places, I believe, they fill tubs or some sort of receptacles with dust and have them taken out of the mine dry ?—Of course it is feasible to remove the great bulk of the dust, but I do not think it is very feasible to remove the dust that is on the ledges of the roads and on the props and, to a certain extent, in the crevices of the stone and even in the pavement. I do not see that it is feasible to remove that. The whole question is, of course, how much dust is required to cause an explosion; probably it is not nearly as much dust as is lying on some roads, and supposing you did remove dust you might leave as much as would be dangerous.

17614. According to some people it might be even more dangerous if you removed part than if you did not remove any at all ?—Yes, it might be.

17615. How about watering the floor only ?—That is a considerable safeguard, I imagine. Unless the watering of the floor damped the dust on the ledges and on the props, I do not see that it would be wholly safe because there might be sufficient dust left on the ledges and on the props to propagate an explosion, unless the moistening of the floor damped the air sufficiently to damp that dust.

17616. You might get the dust down by means of air blasts ?—I think that is impracticable.

17617. You say that you in Scotland are of opinion, with possibly one or two exceptions, that the General Rules of the Coal Mines Act, 1887, and the Explosives Order of 1906 applicable to coal dust are quite sufficient, and that in any future legislation dealing with the subject if any more stringent rules and regulations are made, such mines as you have referred to should be exempted. You mean mines either where there is not a great deal of coal dust or else where the coal dust is of such a character as to be non-explosive or non-inflammable ?—Where the coal dust is dangerous, I do not think the question of quantity need be taken into consideration.

17618. You say that with possibly one or two exceptions in Scotland the General Rules of the Coal Mines Act, 1887, and the Explosives Order of 1906 applicable to coal dust are quite sufficient. What are the exceptions to which you refer ?—I state as one exception this Denny mine of ours, and of course that is the only one that comes under my knowledge. The inspectors for Scotland, Mr. McLaren and Mr. Ronaldson, gave evidence before the Commission, and I think both of them stated that there were one or two mines, but not more than one or two, that were dangerous from the point of view of dust.

17619. When mines are dangerous from the point of view of dust you are of opinion that the General Rules of the Coal Mines Regulation Act, 1887, and the Explosives Order are not sufficient and that they ought to be supplemented, as I understand ?—I would not like to say that they are not sufficient, but I think they should be strengthened, because I believe that if the General Rules under the Coal Mines Regulation Act and the Home Office Explosives Order were carried out, very very few explosions would take place from dust.

17620. But, still, you do suggest that they should be what you call "strengthened" ?—Yes.

17621. I should like to know in what direction you think they should be strengthened ?—Of course I have not thought of a rule, but probably the area should be increased, for instance, for watering round about a shot; that is one matter.

17622. You suggest that possibly it might be well to increase the area. The area now is 20 yards; you think it might possibly be desirable to fix an area of more than 20 yards for watering round a shot ?—Yes. From what I have read in the evidence of people who have studied this matter sufficiently, I understand they suggest 50 yards; therefore, the area round about a shot might be slightly increased from 20 yards. I think that would be a precaution which should be taken if it were found necessary after experiment.

17623. What other suggestions would you make with regard to strengthening the rule ?—I do not know of any other, unless the penalty were made greater for breaking the Rules; because I think if the Rules are carried through there is not very much danger of accident.

17624. With regard to carrying the Rules through, a suggestion has been made that it might be desirable that there should be two different men who should be responsible for every shot that is fired—not only that the manager or under-manager should give authority for shot-firing, but that there should not be one person who is responsible for going down and drilling the hole and putting the substance in to fire the shot, but that two men should always do it, and that one man should always carry the stemming and another man should make the hole, say; so that there should be always two persons engaged in shot-firing, and that if one man was inclined to break the rule the other man would be close by and would tell him that he must not do so ?—I suppose that means two officials because, as a matter of fact, there are always two men at the firing of a shot.

17625. There must be two ?—I mean in safety-lamp pits; there is the official who is the shot-firer appointed by the manager, who is not a contractor nor employed in doing the actual work that the shot is to deal with, and then there is the man who is actually doing the work there, so that there are always two men employed in firing a shot.

17626. Must the man who is at the work be there ? He may be away ?—He may be away, but as a rule he is there. It could be made a rule that he should be there.

17627. (*Mr. Wm. Abraham.*) The point is this: is it desirable or is it safe that the same man who carries the explosive should also carry the means of firing it ?—I think so; I see no great danger in that.

17628. You see no danger in the workman providing himself with the explosive and also providing himself with and using the detonator ?—Of course, if it is the workman who does it, then it must be an open-light pit; if it is the fireman who fires the shot—the shot-firer—then, of course the workman does not have the two things; at least in our collieries if the workman supplies the explosive, the shot-firer brings the fuse and the igniter.

17629. Then you agree that it is not desirable and does not tend to the safety of the mine or of the men in it that one man should have control of both the explosive and the means of firing the shot ?—No, I do not agree with that at all. I think you are misunderstanding me; although in practice with us the miner has the explosive, and the shot-firer has the fuse, the detonator and the magneto for firing the shot, although that is the practice, I see no danger in the one man carrying the whole three.

17630. (*Chairman.*) It is not so much that you see no danger, but the danger is that somebody may break the rule. If the rule is observed, there is no danger, I quite agree; but the point is that it is less likely that two people should combine to break a rule than that one person should break the rule ?—Of course, I do not know whether you mean two officials.

17631. No, not necessarily; one must be an official and the other would be the workman ?—It could be made a rule that the man in whose place the shot is to be fired should always be present at the firing of the shot, along with the shot-firer.

17632. (*Mr. Ratcliffe Ellis.*) You are speaking of the working face now ?—Yes.

17633. But the Chairman is rather speaking of in the haulage road ?—But even in the haulage road the man would be there also; the man who would be working in the haulage road would be there at the same time.

17634. (*Mr. Wm. Abraham.*) The point is as to the danger of allowing one man to have the explosive and the means of igniting it ?—Yes.

17635. (*Mr. Ratcliffe Ellis.*) Where you use permitted explosives, of course, the collier, or the man who gets the coal, is not allowed to fire his own shot, but it must be a competent person, and there would be two people present in that case. Where there are naked lights and powder is used, and the collier fires his own shot, there is no such regulation. The question is whether you would apply to those cases the same regulation ?—I understand your point.

17636. (*Chairman.*) Is it the case that in the use of permitted explosives there must in all cases be two people present when the shot is fired, because in the case of Maddison at the Wingate explosion there was only one present ?—There is no rule.

17637. The rule says that it should be fired by a competent person, but that is the point, that the competent person may possibly break rules, even although he is a competent person, and the suggestion is that the rules are less likely to be broken if the competent person has somebody with him who might perhaps object to his breaking the rule ?—As a general rule there is the workman there.

17638. Yes, but not always ?—I do not think he would be always there, but I think it is in very few cases that he

Digitized by Google

Mr. J. T. Forgie.

18 April 1907

would not be there. As a rule there are two men at each face, and there are always two or three men at each work, whether it is repairing a haulage road or working at the coal; one may be out, but in all probability the other man is there, except in the case of shots in coal wrought during the day and prepared during the day, the hole being bored in the day; then the shot-firer coming at night to fire those shots, of course, there would be nobody there.

17639. But in the Wingate explosion, as I understand, there were a number of men working in the mine, and a duly-authorised man came and fired a shot which he had no business to fire: if anybody had been with him, even if an ordinary collier had been with him, he would probably have known better than to fire a shot of that kind?—Yes.

17640-43. (*Mr. Smillie.*) It appeared in that case that there were actually two men, one of whom carried the detonator, and in that particular case they broke the rule, and the man who carried the detonator also had the explosive that day from his neighbour?—I understand that was the case.

17643A. (*Mr. Wm. Abraham.*) The point that we have now under consideration is the desirability of making that rule a General Rule, because the Special Rules are left to various districts, and we have found since we have been sitting here that in some districts they have a very carefully drawn rule, and in other districts the matter is very much open to improvement, and probably in those districts where it is the more necessary they are the least stringent. Do you agree that these rules which have proved to be so necessary in some parts, and the non-observance of which in one case caused the loss of the lives of many men, should be made a General Rule?

(*Mr. Ratcliffe Ellis.*) You must remember that the object is to have as few people as possible in the pit when these shots are fired.

(*Mr. Wm. Abraham.*) But that is not the point as to firing; the point which was raised yesterday was as to preparing the shots—the collier carrying the explosive, but that he should not also carry the detonator.

(*Witness.*) Of course that is for the purpose of preventing the one man being able to fire the shot.

17644. (*Chairman.*) What Mr. Abraham suggests is that the practice which is in vogue in a great many mines, namely, that the same person shall not carry the explosive and the detonator, ought to be made a General Rule applicable to all mines where shots are fired in the daytime?—I do not think it is a necessary rule at all, that two men should be employed upon it. I think if you get a reliable man and make it a rule that that man is to do a certain thing, then, of course, it is for the management as far as possible to see that he does it and to punish him very severely if he does not do it.

17645. (*Mr. Wm. Abraham.*) Would you think it advisable that a collier who needs to prepare and fire a shot during his shift should be the man to carry the explosive for that shot and his detonator, and to ram the hole? Would you think that safe?—Of course, I presume you are treating this as a matter not connected with coal dust at all; it is simply the question of the danger of the shot, is it not?

17646. It is the question of shot-firing?—If he is careful I do not see that there is any danger. Of course if a man is careless there is every danger, but if he is careful to keep the materials separate, I do not see that there is any great danger in it.

17647. (*Sir Lindsay Wood.*) But is not the rule that permitted explosives are to be employed and that one man who is authorised by certificate is to fire the shots?—Yes.

17648. But he does not carry the explosive?—No.

17649. The other man carries the explosive?—I do not know about that being so in every case; in our case he does not carry the explosive.

17650. In nearly all cases, the one man himself carries the explosive and makes the hole?—Yes.

17651. Then the authorised shot-firer comes with the means of firing the shot and puts the explosive into the hole before doing so?—That is so.

17652. There are two men and each of those men has a separate part of the operation to perform?—Yes.

17653. One has the explosive and the other has the detonator?—Yes.

17654. (*Mr. Wm. Abraham.*) But you do not think that is necessary?—I do not think that from a safety point of view it is necessary so far as shot-firing and the carrying of explosives is concerned. But you brought forward the point that it is desirable to have two men. I say that there are two engaged, but I see no danger in a man carrying all the three items or having the whole of the three; and, of course, if the employers are in the future to supply the explosives, as is suggested, the employers' officials afterwards may have to carry down the explosive also. I do not know how far that would go.

17655. (*Sir Lindsay Wood.*) Do I understand you to mean this, that you see no danger in the authorised shot-firer carrying both the detonator and the explosive?—None whatever.

17656. (*Chairman.*) I understand the whole point is this, that if people attend to the rules it is perfectly clear that the rules are quite sufficient. What we have to consider is the tendency of human nature not in every case to obey the rules, and human nature being what it is, and even mine officials being sometimes guilty of contravening the rules to the great danger of other people, it might be as well, in certain cases where it can possibly be done, to provide that two persons should be concerned in the particular operation, so that one man should be a check upon another. That is the suggestion?—Yes, I quite appreciate that one would be a check on the other, but, of course, I think at the same time it is to a certain extent an unnecessary expense.

17657. With regard to watering zones you suggest that such zones might be arched with brickwork; you probably think that would be necessary, and that if they were not arched with brickwork but simply left timbered, they could not be kept sufficiently free from dust?—Yes, just as I mentioned before, that the difficulty would be to remove dust from an ordinary roadway.

17658. Unless you watered it thoroughly?—Unless you watered it thoroughly.

17659. But if you had a brick arch and the circumstances were such that you could not water thoroughly, a brick arch might be cleaned down sufficiently, I suppose?—Yes. There is no doubt in my mind that watering, where it can be done safely, is the best means of avoiding the danger from dust.

17660. Then you say you have not anything to tell us about the length of zones, and you think that that matter ought to be inquired into experimentally?—Yes.

17661. As regards screens, which is a point that you have mentioned, you say you do not think there is much danger of coal dust being carried down from the screens in mines in Scotland, where the shafts are generally wet. But if they are not generally wet I suppose a lot of the dust might come down from the screens if they were near the pit?—Our coal, except in some cases, is not very dusty coal. In Scotland I do not think that point applies very much. Besides, the tendency nowadays is to have the screens removed from the pit-head and to have them under separate cover.

17662. Therefore you have not seriously taken into consideration the question of preventing by means of fans or by means of damping the dust by steam jets in the pit, or methods of that kind?—We have taken no steps whatever in that direction; we have never given the matter consideration, because our shafts are mostly all wet, and the dust does not get away from the pit bottom at all.

17663. (*Sir Lindsay Wood.*) In order to make the case with regard to shot-firing more clear, I think I should like to put it in this way. There seem to be three or four different modes of firing shots, or three different places where the shots can be fired—one is during the daytime when the men themselves are working, and that is duplicated again by the case of their using powder with open lights, or using permitted explosives with safety lamps; then there is the other case of firing shots on the main haulage roads. I should like to know what your idea is, taking the first case, whether a man, when he has an open light himself and is using powder and not permitted explosives, should be allowed to fire his own shots or not?—It has been the custom in Scotland to allow that man to fire his own shots in the past, because he is allowed to use an open light, under the assumption that there would be no danger from firedamp, owing to the fact that the mines are not dusty. I see no harm in allowing a man to fire his own shot in those cases.

17664. You think there would be no necessity to have any conditions made or rules formed to prevent that being done?—Not from the danger point of view, so far as an explosion is concerned. I think the only question which would arise there would be the danger from the explosion itself to the man. There might be a little more stringent

Digitized by Google

regulation made with regard to the handling of the explosive.

17665. And the amount of explosive to be used ?—And as to seeing that they got the proper explosives. Of course in the case you mention powder is used, and it does not apply in that case.

17666. Then next there is the question of firing the shots at night. Where the shots are fired at night it is all done by permitted explosives and not with open lights and gunpowder ?—In our open-light pits all the shots are fired with gunpowder and with open lights where the open-light pits are.

17667. At night ?—Yes, when there is no dust.

17668. That is only when the men are working in the mine, but not when the men are all out of the mine ?—Yes, even at night, in the main haulage roads.

17669. I am confining my question now to shots at the coal face. There are cases where permitted explosives are used and shots are fired at night when all the men are out of the pit ?—At the face ? We have no such case at all.

17670. There are such cases ?—There are such cases in England, I believe, but I do not think in Scotland that state of things exists.

17671. In those cases the shot-firer would load the shot and also explode it ?—Yes.

17672. Is there any harm in that ?—No.

17673. You would not suggest that there should be any additional rule for that purpose ?—I do not think so ; I see no necessity for it.

17674. Then, where shots are fired with permitted explosives during the ordinary coal working in the face, do you see any reason why the shot-firer, the authorised man, should not carry both the explosive and the detonator ?—No, I see no reason, although he does not do it at the present moment with us in Scotland. I see no reason against that.

17675. You think there would be no danger in it ?—No danger.

17676. In haulage roads where shots are fired in dusty mines, you think there ought to be a considerable area watered round the shot, and that the shot should be fired also under strict regulations ?—Yes.

17677. That is in main haulage roads, especially in dusty mines ?—Yes ; it is dusty mines that I am referring to.

17678. Where there is no dust, but the mine is a wet mine, you would allow explosives to be used anywhere ?—Yes, anywhere, and with open lights.

17679. I see in the returns there are a great number of explosions in Scotland where open lights have been used Can you give any reason for that ?—Well, they are called explosions, but as a matter of fact very few of them are real explosions ; they are more ignitions of gas and of firedamp. Of course those are mostly long-wall workings, and there are small holes in the roof from which pieces of stone come out, and in doing what is called in Scotland "brushing," that is to say, roof ripping, gas may collect to a very small extent there, and it is kindled, and probably it singes a man, but it does not do much harm—generally it is not a serious injury. According to the Act of Parliament we have to report every one of those cases ; the most trifling accident, so long as it is an ignition of gas or a so-called explosion, has to be reported.

17680. But there are a number of deaths caused by such explosions. There were 74 fatal explosions causing 109 deaths in the 10 years, from 1896 to 1905 ?—I have only taken 1905. There were two deaths in Scotland in 1905, and of course the 10 years which you mention might include the Denny explosion, in which there were 13 deaths, and it might also include the Drumpeller explosion, in which there were five deaths. I took the last year for which there were statistics available, 1905, in which there were two fatal and seven non-fatal cases.

17681-2. (*Chairman.*) In 1904 there were eight fatal explosions, causing nine deaths, and in 1900 there were 14 cases, causing 22 deaths ?—Yes.

17683. (*Sir Lindsay Wood.*) Is it at all due to there being more naked lights used in the mines in Scotland than in other mines ?—I should think the great bulk of the explosions and ignitions of gas and burnings take place in open-light pits. I know from our own experience where we have introduced safety lamps we have reduced the number of accidents from explosions, and we have reduced those small burnings, and have reduced the number of returns made to the inspector. But I should like to impress upon you that with regard to the large number—97 cases—that are referred to here as being injured, the injuries were very trivial indeed, and the cases are simply recorded here because we are obliged, under the Coal Mines Regulation Act, to report every case in which an explosion of gas occurs, and in which a man gets injured, no matter how trivial the accident is.

17684. (*Chairman.*) But has the number of accidents from other causes increased when you had these lamps, because you told me that lamps were dangerous ?—I should put it in this way ; I should not like to say that they have increased—I have not gone into that specially—but they have not decreased, and, of course, we are always supposed to be improving.

17685. (*Sir Lindsay Wood.*) I have the return for Scotland here, and I see that in 1896 there were nine deaths, in 1897 there were six, in 1898 there were 17 ?—I think 1898 was the year in which there was the Denny explosion, the 13 deaths.

17686. In 1899 there were 15, and in 1900 there were 16 ?—Yes.

17687. (*Chairman.*) There were 22 deaths in 1900, if you take, not the numbers of explosions, but the deaths ; there were 14 explosions and 22 deaths, eight in East Scotland, and 14 in West Scotland ?—Yes.

17688. (*Sir Lindsay Wood.*) I see that is so. They are certainly out of proportion to the rest of the districts, excepting where there have been these very large explosions due to coal dust ?—Yes.

17689. Do you think there would be any great objection to using safety lamps more frequently than they are used ?—I think there would be, in the steep workings.

17690. It would be better to use them ?—No, there would be great objection to increasing the use of safety lamps in steep workings.

17691. Upon what ground ?—On the ground that it is more difficult for the man to keep the lamp alight, and that if it goes out he has the difficulty of getting to the lighting station. It is not like being on a level road or flat working ; his lamp would be very much more liable to go out.

17692. That is in the very steep mines ?—In the very steep mines.

17693. About what is the gradient of which you are speaking ?—Anything from 1 in 4 and 1 in 5 upwards, and even 1 in 2 ; for instance, in the Edinburgh district and the pits in Fife, they are nearly all worked with open lights, and the mines there are very steep. In the Edinburgh district you have them as steep as 1 in 2, and 1 in 2½, and in Fife the great bulk of them are 1 in 4 and 1 in 5.

17694. Do the men in your district take more than one lamp into the mine to each man ?—No, only one safety lamp to a man.

17695. Is that the general rule ?—That is the general rule. Of course, at stations where there is a bench there may be an extra lamp or two supplied ; the bottomers take down an extra lamp or two.

17696. I understand it to be your opinion that you cannot by sweeping remove sufficient of the dust to make it certain that you would not have a dust explosion ?—No; I think in a Scottish mine certainly it would not be possible.

17697. Or in any mine ?—In most mines, I should think, it would be impossible.

17698. (*Mr. Enoch Edwards.*) I understood you to say that you had not had any experience outside Scotland ?—None.

17699. You say that the many explosions which you have had in these naked-light pits are not really explosions ?—A number of them are not.

17700. That is to say, there is a little gas here and there where you have had a fall, and so on ?—Yes.

17701. What do you call them ?—Ignitions of gas.

17702. What is the difference between an ignition of gas and an explosion ?—It is perhaps a very fine point ; I mean to say the quantity of gas is so small that it develops no appreciable force ; it just ignites and burns. Beside that, probably the gas is not mixed in the proper proportion with air to cause an explosion ; unless gas is mixed in a certain proportion with air you cannot explode it, although you can kindle it and it will burn. I think that is the difference, that the gas lying there is not intermixed with the proper proportion of air to make it explosive, and that it simply burns as it would burn at a gas-jet.

Digitized by Google

Mr. J. T. Forgie.

18 April 1907

17703. You say that a number of these are quite minor accidents which you have to report ?—Yes.

17704. That is to say, that a little more gas would make them serious ?—Well, quite a considerable amount more, a good deal more gas.

17705. In those explosions which have been serious, how much more gas has there been ?—It is difficult to say. As a rule there is not a very great deal of gas. The explosion is often caused by a sudden outburst of gas getting mixed with the air.

17706. If you have a sudden outburst of gas, what protection have you where you use naked lights ?—Well, we have very little.

17707. The figures quoted are rather serious, after all ?—Yes, they are serious.

17708. You do not yourself think that it is possible to reduce them by continuing the use of naked lights ?—Of course as regards those small burnings, and even some of the serious ones, it is possible to reduce them if everybody did what they ought to do, but of course they put their open lights into holes in the roof.

17709. Sir Lindsay Wood has put to you the figures of the average number for several years ?—Yes.

17710. It is a serious number, after all ?—Yes, I admit it is serious.

17711. I understand you suggest that the reason why you cannot adopt the system of safety lamps generally is because of the sharp gradients of your mines ?—That is so to a great extent.

17712. You have no experience of mines outside Scotland ?—I have none.

17713. So that you are not aware of mines which have quite as sharp gradients as yours, and indeed sharper, where there is no difficulty in using safety lamps ?—Yes, I am quite aware that there are such mines using safety lamps ; but my point is that you would probably reduce the one source of accident and increase the other by using safety lamps in mines of that character.

17714. But I wish to put it to you that there are outside Scotland mines of much sharper gradient than those which you suggest, where they use safety lamps ?—Yes, I understand that there are.

17715. There is no evidence that there is an increase in the rate of accidents from other causes because of that ?—I have no evidence that the number of such accidents has been increased. Of course I have not heard that the number has not been increased ; I have no evidence to that effect, but it is quite possible that the other accidents might be reduced if they used open lights.

17716. The evidence which we have taken up to now has been from districts where the use of safety lamps is the universal practice, and I am not aware that it has been stated anywhere that the number of accidents is due to the use of safety lamps ?—I cannot give evidence that that is so, but as practical men we see the difficulties which would arise with safety lamps in steep seams as compared with the use of open lights.

17717. But you have no statistics enabling a comparison to be made ?—No, we have none. I think I mentioned to the Chairman that Mr. Mowat has some statistics to give upon that point. Perhaps you will put the question to him ; he will be able to give you the figures, and he has them from practical experience.

17718. Does the objection to safety lamps in your case come from the workmen or from the employers ?—From both.

17719. Is it mainly on the grounds which you suggest now ?—Not wholly, because the mines in Scotland are not all steep ; all round the Hamilton district there are flat workings where safety lamps are nearly entirely used.

17720. Is it only in the mines which have sharp gradients that there are no safety lamps used ?—No, there are some flat mines where there are no safety lamps used ; but I do not know of any steep mines in Scotland (I think Mr. Smillie will bear me out in this) where there are safety lamps used ; I cannot recall one at the present moment, but I am open to be corrected if Mr. Smillie mentions one.

17721. You suggest that the reason for it is entirely the sharp gradient ?—I do not say that is wholly the reason, but it is to a great extent, because there is no necessity for them.

17722. But you do not wish to suggest to this Commission that there is no necessity to introduce safety lamps where there have been so many accidents ?—It has been considered in the past that there was no necessity for it, because it has been considered in the past that taking the number of accidents broadly over all, it was as safe, as if not safer, to work in those mines with open lights than with closed lamps.

17723. What evidence is there that if you reduce the number of accidents from explosions you increase the number of accidents otherwise ?—We have no statistical evidence. As I say, I think Mr. Mowat will be able to give you a case in point of his own. I have no direct evidence that the accidents from the one cause are greater ; but as practical men we are of that opinion ; we see the difficulties.

17724. But you have, no doubt, seen the statistics which are issued with regard to accidents in other districts, as you have taken a great interest in the matter ?—With regard to other accidents, I think Scotland does not compare badly with the rest of the country. Of course with regard to explosions, as you have stated, during the last 10 years I must say the number of explosions is serious.

17725. Of course your suggestion is that accidents are more frequent, that is to say minor accidents from falls of roof and sides in pits, where lamps are used, as a consequence of using lamps ?—I do not exactly say that, but I say that in those mines which are worked with open lights now in Scotland and which are to a great extent steep mines, in our opinion accidents from other causes would be more liable to occur with safety lamps than with open lights.

17726. I suppose your holding that view is the reason why you oppose the introduction of safety lamps ?—Yes, that is why I do so.

17727. Have you had any experience whatever yourself personally in explosions ?—Do you mean explosions of dust.

17728. Either of dust or of gas, or both ?—You mean have I been in an explosion ?

17729. Yes ?—No.

17730. Have you had under your charge a colliery the conditions of which you have known at the colliery before and after the accident ?—With regard to dust I have had no experience beforehand further than having visited the colliery. With regard to the colliery that I took charge of after the accident I did not have the management of it, but I happened to be in it once or twice before.

17731. So that you have no direct knowledge, from the mine being under your own control and management, of the condition of a mine before an explosion and afterwards ?—I am very pleased to say that I have no experience in that respect.

17732. Therefore, as to the question of the length of watered zone or dry zone, you have had no experience to warrant you in expressing that opinion ?—I cannot give an opinion. I recommend in my evidence in chief that experiments should be carried out on that subject, and that they should be carried out in as natural a way as possible, making the experimental chambers as near to the condition of the mines as they could possibly be made and testing the matter in that way. I think it is only by experiment of that kind that you can possibly arrive at any definite conclusion.

17733. I suppose you agree generally with the witnesses who have been called here that if you remove the dust you remove what feeds the explosion ?—Yes. I think I state that at the beginning of my evidence, where I say that if the accumulations of explosive dust are either removed or treated in some way to make them non-explosive, you at once take away that factor which is dangerous.

17734. (*Mr. Smillie.*) Was the Denny mine an open light mine ?—No, it was a safety lamp mine.

17735. So that for that year, the year in which the Denny explosion took place, the larger number of deaths from explosions in Scotland was in a closed light pit ?—Yes.

17736. I think you agree that Scotland has earned a rather unenviable reputation with regard to explosions from naked lights ?—Yes, it does seem to be so from the figures.

17737. Of course there is a very large proportion of the coal in Scottish mines wrought by naked lights ?—Yes, a very large proportion.

17738. Then that would explain to a great extent the reason for it ?—It would, to a great extent.

17739. Are you aware that in many of the explosions in the naked light pits in Scotland there has been

Digitized by Google

considerable violence caused by the explosion ?—Yes, most distinctly, in some of them.

17740. And that there have been doors blown down and brattice blown down ?—Yes, that is the case.

17741. You would not call those merely "ignitions" ?—No. I did not say in my evidence that the whole of them were ignitions. I said a great number were simply ignitions of gas, and that a large number of the reports by the inspectors are simply of cases of ignitions.

17742. If you were told that in regard to the explosions which have ended fatally in the majority of cases there has been considerable violence, you would say that that was an "explosion" ?—Of course I am taking the whole of Scotland. There were several at our own collieries but certainly the majority of them in our case are not violent explosions.

17743. In an explosion causing serious injury, serious burning or death from burning, you would say that there must be a considerable quantity of gas—I mean not simply the gas that you would find coming from a little hole in the roof where a stone had fallen out ?—No, there need not necessarily be a great quantity of gas; a great deal depends upon the space in which the workman is working. Of course if the space is confined, a small quantity of gas will cause a more violent explosion.

17744. Have you yourself had personal experience of the ignition of gas; have you yourself ignited gas ?—Yes, several times.

17745. Have you on any occasion ignited a considerable quantity of gas without causing any injury to any person ?—Yes. On one occasion I was travelling round an ironstone face—an ironstone wall; the seam was about 2 ft. 3 in., and going up there we came upon a body of gas which burnt for at least five to seven seconds and travelled along about 20 ft. of the wall; we went down on our faces and lay on the floor with the gas burning over us. The extent of the flame was at least 15 to 20 ft. long. The point is that the gas is lying there unmixed with a proper proportion of air to cause it to be explosive, and it simply burns where it meets with the air along the edge of the air until it consumes itself.

17746. Are you aware that in many of those slight explosions in Scotland, they have occurred in mines in which gas has been found repeatedly, and that it has been reported in the books ?—Yes, I believe that is so. Of course you must understand that gas being found in a colliery and reported in the books does not mean gas which is lying there. If you find a feeder of gas, according to the Act of Parliament you are bound to report it. Of course the coal is always giving off gas, and if there is a strong feeder of gas and it shows itself in the lamp it is bound to be reported; but it may be at once carried away by the air.

17747. Are you aware of any case in which an explosion has taken place in a naked light pit where there have been found considerable quantities of gas repeatedly and reported ?—No, I am not aware of any such case.

17748. Would you be astonished to hear that it is so ?—I will take your word that it is so, but I do not know of any such case.

17749. I know that from my experience of enquiries into accidents ?—It is not my experience that such has been the case.

17750. In many of those cases there must have been a breach of General Rule 1 ?—Not necessarily.

17751. General Rule 1 provides: "An adequate amount of ventilation shall be constantly produced in every mine to dilute and render harmless noxious gases" ?—Yes.

17752. Those gases which have caused an explosion were not rendered harmless ?—No; they may not have been there when the fireman made the inspection.

17753. But if the ventilating current had been sufficient, they would not have gathered at all, unless in the case of a sudden outbreak ?—Yes.

17754. (*Mr. Ratcliffe Ellis.*) I think you should read the preliminary section, Section 49, which says: "The following General Rules shall be observed, so far as is reasonably practicable, in every mine" ?—That is so.

17755. (*Mr. Smillie.*) I am putting it to you that proper precautions have not been taken in all the cases where explosions have taken place in naked-light collieries in Scotland. It may not be within your own experience ?—Of course, I am not able to speak for other people, but it is quite possible for gas to collect and for there still to be quite a sufficient amount of ventilation passing along the ways. In regard to those holes in the roof, it is sometimes very difficult to ventilate them.

17756. The majority of your collieries are closed-light pits ?—In Hamilton district they are all closed-light pits, but our collieries in Ayrshire are, of course, open-light pits.

17757. One objection to the use of safety lamps is the steepness of the workings in many of the collieries in the Fife district and in the Lothians ?—Yes, more especially in the Fife district and in the Lothians.

17758. You have had experience of naked-light collieries and closed-light collieries ?—Yes.

17759. Do you think it is possible for a workman to examine the roof and sides of his working place as carefully with a closed light as with an open light ?—It is possible for him to do it, but he cannot do it so readily nor so well, and there is very great danger, of course, especially when he is examining the roof, of his putting out his lamp in doing so, especially if there is a chimney on the lamp.

17760. Your fear is, although you have not any statistics yourself to prove it, that by unnecessarily introducing safety lamps you might increase the danger from falls of roof and sides and haulage accidents ?—Principally haulage accidents. Of course, it would have the same effect as to falls of roof and sides, but my point is more especially with regard to haulage accidents.

17761. I find that in the Explosives Order a "competent person" is mentioned as being required to be appointed by the manager to shot-fire ?—Yes.

17762. The question of competency is left entirely in the hands of the manager ?—That is so.

17763. That competent person does not require to hold a certificate of competency ?—No.

17764. Is there any examination made by the managers who appoint the persons as to their knowledge of explosives ?—I do not think so.

17765. That is to say, theoretical or practical knowledge ?—No, certainly not theoretical. The person appointed is generally a workman who has had large experience in firing shots for himself on doing work for himself.

17766. Would you say that 90 per cent., if not the whole, of those who are competent shot-firers, have no theoretical knowledge at all as to explosives ?—I should have no hesitation in saying that.

17767. Do you think it is necessary that there should be an examination made of some kind, and that a certificate should be awarded for competency in such a serious matter as this ?—Do you mean as to theoretical knowledge ?

17768. As to theoretical or even practical knowledge ?—As to theoretical knowledge, I should say there is no necessity for it.

17769. Then as to practical knowledge ?—I do not think there is any necessity for such an examination, because it is simply as to firing shots. Of course, the manager must satisfy himself that the person appointed is a reliable man.

17770. Is any enquiry made by anyone other than the manager as to whether or not the person appointed is a reliable man ?—Well, going round I ask the managers if they are looking after matters and complying with the Act and seeing that all their appointments are made in accordance with the requirements of the Act. I do not go into each case as to every shot-firer and ask whether the manager has made a special examination into the question of his competency.

17771. A fireman has to be a competent person appointed by the manager. Do you think it is necessary for a fireman to hold a certificate of competency proving that he is a competent person ?—There might be no harm in it, but I do not see any great necessity for it, because the manager appoints a man who is as a rule a reliable man; and again, there is no necessity for the man to have any theoretical knowledge.

17772. The Mines Regulation Act makes it necessary that a competent person should be appointed for the management of a mine, but as a proof of the competency of that person he has to hold a certificate, which is granted after examination ?—Yes, but there are quite as good men who do not hold certificates.

17773. I quite agree with you, but the law says that a manager must hold a certificate ?—Yes.

17774. And that is a proof of his competency. He might even then be incompetent, but still that is a proof that is

Digitized by Google

Mr. J. T. Forgie.

18 April 1907

taken ?—As a proof that he is competent to manage the mine.

17775. Would you have the same opinion with regard to a fireman who is supposed to be a competent person, or a shot-firer who is supposed to be a competent person ?—No, I think it goes far enough when it is left to the manager.

17776. There might be persons appointed to that position who are absolutely unqualified for it ?—Of course that would rest with the manager ; he should see to that.

17777. The manager is not responsible in any case where an explosion takes place through the fault of the fireman ? —I think if it could be shown that he had appointed a man who was not competent he would be held to be responsible.

17778. Your mines in Lanarkshire are supposed to be fiery mines, or at least they are in what is called the fiery zone ?—Yes, or rather which was the fiery zone ; it is much less so nowadays.

17779. The coal there has been wrought with closed lights on the ground that it was considered at one time a fiery mine ?—That is so.

17780. Some of your mines are quite close to Udston Colliery and to Dixon's Collieries at Blantyre ?—Yes.

17781. Some years ago there were serious explosions in both of those collieries ?—That is so.

17782. Do you know whether or not dust played an important part in those explosions ?—I do not know for a fact, but it is supposed now, and I think there is no doubt that the general opinion is that dust fired it.

17783. Do you remember the extent of Dixon's Colliery before the accident ?—It extended over a very considerable area.

17784. Some miles ?—There were miles of roads. The workings were not very extensive at that time.

17785. There were three collieries communicating with each other ?—Yes, but they were not very far apart.

17786. The explosion traversed the workings of at least three of those collieries ?—No, I think only two.

17787. Do you think there was an accumulation of gas in Dixon's Colliery sufficient to traverse all those miles of workings unless it was fed by coal dust. I mean do you think so from your experience of coal dust since then ?— I have formed the opinion and have held it now for two or three years since this coal dust theory has been brought forward, that there is hardly a large colliery explosion that has taken place that has been due wholly to gas ; and I do not think it is possible for the spaces in a colliery to be filled with an explosive mixture of gas and air so as to cause a large explosion like that. I think in every large explosion it is bound to have been augmented and extended by dust ; the initial explosion may have been caused by firedamp. That is, of course, an opinion.

17788. All the collieries in Lanarkshire, in what is considered to be the fiery zone, are working the same seams, or have been working the same seams, as were being worked in Dixon's Colliery and Udston Colliery ?—Yes, only it is under very different conditions.

17789. My point is that if in Dixon's Colliery, Blantyre, and Udston Colliery, Blantyre, dust played a part in the explosion, the same thing would naturally take place in other collieries under similar circumstances ?—Yes, under similar circumstances, but the collieries are under very different circumstances. Our collieries are working the same seams, but we are working under very different conditions ; and I should like to point out that the workings were stoop-and-room workings in those cases. Long-wall working puts it on a very different footing to the stoop-and-room working.

17790. You think there is less danger from dust in long-wall than in stoop-and-room working ?—There is far less danger from dust in the long-wall than in stoop-and-room. To start with, any dust that is made at the face gets mixed there with an amount of foreign material, and all along from the brushing of the roads and the heightening of the roads afterwards there is a constant admixture of foreign material as against any small additional quantity of coal dust that is deposited. The dust in long-wall workings (we have proved this in our own pits) is daily becoming of a less explosive character, if a mechanical mixture of foreign material with the dust reduces the danger. Of course that is a matter to be tested.

17791. You work with different safety lights now to what were in vogue at the time of those two explosions ?—Yes. With regard to Udston explosion I do not remember whether it was the old Scottish lamp that was used or not ; I think it was. But in the case of Dixon's Blantyre Colliery certainly it was the old Scottish lamp that was used.

17792. The lamps that are now being used are considered to be a great deal safer than the old Scottish gauze lamp ? —I think the lamps in the Hamilton District are the best that can be got in any colliery.

17793. You employ a very large number of foreign workmen at your collieries ?—We do, but the number is not so large now. We used to employ more than we do now.

17794. At some of your collieries 50 per cent. of the workmen are foreigners ?—Not at the present moment.

17795. During the last six months at your Bothwell Park Colliery were not 50 per cent. of them foreigners ?—No, we never had 50 per cent., and I do not suppose that at the present moment there are much more than 12 per cent. or 15 per cent. All over our collieries I do not suppose there are 10 per cent. of foreigners.

17796. Do you know whether or not those men, prior to being employed in your mines, knew anything whatever of mining ?—Before they came into Scotland I suppose few of them ever saw a mine in their lives. Some of them, of course, came from Germany and Belgium, but I think the great majority who came to Scotland never saw a mine in their lives until they came to these collieries.

17797. Are they employed quite freely at your collieries ? —Under charge of another man. The manager makes enquiry as to every man.

17798. Are there cases in which one foreign workman in your employment employs as many as 20 or 30 foreign workmen ?—I could not answer that. It may be so.

17799. If we were to bring forward statistics to show that, do you know that from your own experience ?—No, but I could easily ascertain with regard to that. Might I say that in any statements which you wish to make here regarding any workmen employed, for instance, the statement about a man employing 20 foreign workmen, if you would give me notice I would look into the matter, and I should then be able to answer the question ; but you quite understand that I have not the details as to all our works at my fingers' ends.

17800. Your Denny Colliery is one of the most dusty collieries, and probably the dust in it is one of the most dangerous dusts that you have in any collieries, because of the nature of the coal ?—Yes. It does not come under my charge. I think the nature of the coal rather points to the fact that it is not so dangerous a dust. It is dangerous, because it has already caused an explosion, but as I have pointed out already, in that explosion the dust was not of a sufficiently explosive character to extend the explosion any distance, or else there would have been another 60, 70 or 80 men killed.

17801. That is really the point I wish to deal with, but prior to coming to that I think you told us—and this is very interesting—that the blast actually passed over a considerable distance of wet zone ?—No, across the dook, I said.

17802. What distance is that ?—Just 6 or 8 feet wide.

17803. I beg your pardon, I thought it traversed a long distance. The wet dook was only a few feet wide ?—Yes, 6 or 8 feet wide—the width of a dook.

17804. Would not the stoppings there, which the force of the explosion blew out, for a moment stop the force of the explosion and prevent the force of the explosion raising the dust behind the explosion and keeping it in suspension ? —It might to a certain extent.

17805. Do you think that this six inches of dust, or a portion of this six inches of dust which was lying there had been raised and was in suspension when the flame came along ?—Yes, my opinion is that it must have been.

17806. Yet there were no signs of charring—proving that it had not been ignited ?—No. I may say at the very start one or two trees shewed ; it was very difficult to tell, but one thought one could see the trace of charring.

17807. Because the flame traversed that ?—Yes, but unless you had known that there had been an explosion you would never have discovered it.

17808. Proving that the flame at that time was not very fierce ?—Yes.

17809. You have no objection to a provision which makes it necessary to water a dry and dusty zone round about the place where a shot is to be fired ?—None whatever.

17810. You are willing that that distance should be

Digitized by Google

extended if it is proved to be necessary ?—If it is proved by experiment and test to be necessary, but only after sufficient experimenting and testing.

17811. Have you formed any opinion yourself as to whether or not coal dust can be ignited by a blown-out shot where there is no gas present ?—I have no experience of it, but I am inclined to believe that it can in certain cases.

17812. But that is largely a matter of theory ?—I am speaking from the experience of other people.

17813. There is a strong feeling amongst employers generally in some of the Scottish coalfields and amongst the workmen generally against safety lamps being introduced, is there not ? You have stated that ?—Yes, there is.

17814. One reason for that I think is that when safety lamps are introduced, there is considerable difficulty in getting rid of them again when the apparent danger has gone ?—That is one of the strong reasons, no doubt.

17815. Is it your opinion that the necessity of putting in safety lamps might arise at a colliery and that within a period of a year or two years the colliery might be perfectly safe to work with naked lights ?—Yes, we have had experience of that kind ourselves. We did take out the safety lamps in a certain colliery at one time where they were put in after an order of the Inspector of Mines.

17816. Do you think that the extra cost of lamps, which were admittedly safer than any other class of lamps, should be a reasonable cause for not putting in those lamps ?—I do not think so—not the direct cost of buying the lamps and supplying them and maintaining them.

17817. You think the safety of the workmen should be the first consideration ?—Yes.

17818. And that the best lamps should be used of course independently of something which was really prohibitive ?—Yes. I am quite clear on that point.

17819. (*Mr. Ratcliffe Ellis.*) With reference to the dust itself, you have mentioned that the mixture of the organic dust of coal with other material is a mechanical mixture and not a chemical mixture ?—I think it must be a mechanical mixture. I have asked that question of our chemist and evidently there is a little difficulty in it. There may be a small portion that is chemical, but no doubt the great percentage of the material is a mechanical mixture.

17820. Do you think that under any conditions it would be possible for the blast in an explosion to separate the dust and to take along with it that which was coal dust pure and simple and to leave the other dust which was mechanically mixed with it ?—I think if the force of the initial explosion were great enough, and the difference of the specific gravity of the coal and the foreign material were great enough too, the fine coal dust might be raised—especially the fine coal dust near the top might be raised by itself—and therefore, you would have a very pure coal dust.

17821. Supposing there was an analysis made of the dust on the road and that, in itself, was pronounced to be not a very dangerous dust, it might become dangerous by the explosion and the blast taking out of it the dust which was of a dangerous character and leaving that which was non-dangerous ?—That is my opinion.

17822. You think that chemists should consider that and examine into the question ?—Yes.

17823. Is it your opinion that taking the organic dust, the pure and simple coal dust, there are different degrees of danger attached to different kinds of dust ?—Yes. Certain coals are more difficult to light than others and the quantity of volatile matters in some coal is very small: for instance, if you take anthracite coal, I do not suppose there is any danger from anthracite dust, and that is a coal which has probably 85 per cent. to 90 per cent. of fixed carbon and only 5 per cent. to 6 per cent. of volatile matter.

17824. Then you would not consider it possible to find that by taking an analysis of the coal you could come to some conclusion as to the dangerous character of the dust from it ?—I think the analysis of coal tested on a large scale would be still more reliable. If you could get the relation between danger and analysis it might be very valuable in the future.

17825. Have you contemplated it at all as being possible that there might be such a difference between the dangerous character of the dust as to justify exceptional measures with regard to it ?—Yes.

17826. You think that what might be necessary in some cases might be unnecessary in others ?—Yes, quite clearly.

17827. It has been put before the Commission that where the explosion has been a coal dust explosion pure and simple, without any gas, it is perhaps an advantage to have an accumulation of coal dust ?—I could not give an opinion upon that point.

17828. But certainly where there is gas the less dust the better ?—Where there is the probability of combustion certainly that would be so. By having a large quantity of dust raised, greater than the quantity of oxygen, you are bound to smother the heat and the flame.

17829. In your own collieries do you systematically remove the dust from the road ?—No.

17830. You let it accumulate ?—We let it accumulate.

17831. And it does not accumulate to any very great extent ?—No. We have not much coal dust in our mines excepting in the Denny mine.

17832. Do you consider that the dust in your own mines is dust of a dangerous character ?—No, except in the Denny mine, and we water it there.

17833. What is the difference ? Have you any objective sign that you can tell us of to show the difference between them ?—The Denny coal is a steam coal: it has an analysis of somewhere about 70 per cent. of fixed carbon and about 19 per cent. of volatile matter: it is a very dry coal and it is a coal which there is a great difficulty in finding a market for in Scotland, and it breaks up into dust. If it were good anthracite coal there would be a little more fixed carbon.

17834. Does it make you very black when you go down into this Denny mine ?—Yes, you get just like a sweep.

17835. If you paid a visit under the same circumstances to the other mine and performed the same exertions, would that make you as black ?—No. These are all more bituminous coals: they have 30 to 35 per cent. of volatile matter. There is another point which I should have mentioned to you. In the Denny coal there is a very small percentage of water; there is only about 2 per cent. of combined water in that coal. In the coal from our Bothwell coalfields there is 9 per cent. of water. Those coals would never make dust in the same way; and even in the case of our Kilsyth coals, where the quantity of water is as low as 2½ per cent. and the volatile matter is about 30 or 32 per cent., the coals do not grind into the same very fine dust that this specially dry coal from the Denny mine, containing 70 per cent. of fixed carbon and 2 per cent of water does.

17836. In regard to the other coal which you speak of, not the Denny coal, do you consider that is less dangerous than the Denny coal ?—The Kilsyth coals; yes, infinitely less dangerous.

17837. I suppose you would have no objection to supplying samples for the purpose of analysis of these various dusts ?—No.

17838. You think that coal is less dangerous; do you say that from experience ?—I say it from actual tests, because in these Kilsyth pits we have had open lights, and we have had those small explosions and ignitions, but we have never had a dust explosion.

17839. Although there is a great deal of dust there ?—There is not very much dust; they do not make dusty mines.

17840. Therefore, from what you say, you think there is really a substantial difference in the dangerous character of different dusts ?—Yes. In this Denny pit the coal is wrought by stoop-and-room, and that I believe increases the danger from dust in that mine. If that mine were wrought longwall, I do not believe it would be so dangerous. In our Kilsyth pits all our seams are wrought by longwall, and the dust is all more or less mixed with foreign material. At the face it begins to mix with the small droppings off the roof, and by a re-stripping of roads it is gradually made worse, and there is a larger and larger percentage of foreign material mixed with it. I believe that has a great deal to do with it. If it can be proved that intermixing of dirt and foreign material with coal makes it less explosive, then our case is an example of it.

17841. Could you state the proportion of the amount of ripping to the quantity that is got ?—Do you mean in cubical quantity or tonnage ?

17842. In any way so as to be able to make a comparison of one with the other ?—Our seams are very thin, varying

Digitized by Google

Mr. J. T. Forgie.

18 April 1907

from 2 ft. and 3 ft. to 3 ft. 6 in.; we have roads about 40 ft. to 45 ft. apart, and in each of those distances the road is brushed; and there is about from 3 ft. or 4 ft. to 8 ft. or 9 ft. taken down at the face, and that is all handled at the face, and the bulk of it is stowed in what we call the "cundie" between the buildings; the roof is taken round and built in the stowage; that goes to form a road about 6 ft. high, and that road gradually comes down. If it is only a drawing road, it is cut off by another road by and bye; but if that road is to be a main haulage road, it has to be re-stripped, because it comes down so low, and probably that road will be re-stripped at least once in the course of its own existence as a drawing road. If it is used as a haulage road, it would probably be stripped three or four times, and from 18 in. to 20 in. taken off it each time.

17843. That is to say, that the method of working causes an organic dust to be mixed with other matter, and renders the whole less injurious than the coal dust pure and simple would be?—That is the result of that.

17844. Where do you consider is the dangerous place with reference to the question of dust, at the face or in the haulage roads?—In the haulage roads. There is no danger at the face at all, I consider.

17845. You are aware that there is a different method of dealing with shot-firing at the face and on the haulage roads?—Yes.

17846. Both in the Explosives Order and in the Act of Parliament itself?—That is so.

17847. What is the danger in connection with shot-firing?—With high explosives the danger is from a blown-out shot. It is supposed that with high explosives, if they are properly placed and the hole is bored to do the work properly, there should be no flame and no danger; but I do not think the high explosives are absolutely safe; they are not absolutely flameless, especially if they blow out and do not do their work, in the way that a cannon does.

17848. It is the danger of having a blown-out shot?—Yes.

17849. If the shot does its work and brings the coal down there is no blown-out shot, and there is very little danger?—There is not so much danger.

17850. What is necessary to prevent a blown-out shot?—First of all it is necessary to place the hole properly to do the work.

17851. The hole should be properly made?—Yes.

17852. Is there any specific rule or detailed rule that you know of with regard to the drilling of a hole? If you look at General Rule 12 of the Act of Parliament you will find it is provided in (*d*) and (*e*) that: "In the process of charging or stemming for blasting, a person shall not use or have in his possession any iron or steel pricker, scraper, charger, tamping rod, or stemmer, nor shall coal or coal dust be used for tamping. (*e*) No explosive shall be forcibly pressed into a hole of insufficient size, and, when a hole has been charged, the explosive shall not be unrammed, and no hole shall be bored for a charge at a distance of less than six inches from any hole where the charge has missed fire"; and in the Explosives Order there is a general regulation, as you will see, in the first part of the Order, that the hole must be properly made: (*b*) "Every charge of the explosive shall be placed in a properly-drilled shot-hole, and shall have sufficient stemming, and each such charge shall consist of a cartridge or cartridges of not more than one description of explosive"?—Yes.

17853. I do not know of any other rules—I do not know whether you do—prescribing as to how the hole is to be drilled?—There is no other.

17854. It is very important that this hole should be properly drilled, that it should be straight, and that there should be no break in the material?—Yes.

17855. Those are all very important things to be done?—Yes.

17856. Do you think it is advisable that this matter should be prescribed in a little more detail, with regard to having the hole in a satisfactory position to put the cartridge?—I do not think it is so very important as to the straightness of the hole, because I do not think the man can go very far off the straight; but I think it is an important point to put the hole in such a position and in such a direction that the explosive will be able to do its work, assuming you put the proper quantity of explosive into it, without gunning—without blowing out.

17856A. Where the shot is fired by a competent person has he an opportunity of seeing before he fires the shot whether the hole is right or not?—He has.

17857. The charge is not put in until he sees the hole?—No. In some cases I believe the charge would be put in by the collier and he would put in the primer.

17858. Is it desirable that there should be any more definite instruction given in a rule as to the drilling of this hole and the charging generally?—There would be no harm in having perhaps a little more detail, that he should see that the hole was in a proper position and likely to do its work, and that if it was not likely to do its work, or if it was likely to cause a blown-out shot he should not fire it.

17859. Do you not think it would be an advantage to have that point a little more carefully defined?—I think it would.

17860. Because if there is no blown-out shot there is less danger?—Yes, there is less danger.

17861. In order to guard against a blown-out shot those precautions are necessary?—I think they are.

17862. You think it would be better to define a little more in detail what they should see to?—I think so.

17863. What do you think of a rule like this: "Before any shot is charged its direction shall be marked out on the roof or other convenient place, so that in case of miss-fire the direction of the hole will be known, and prevent the relieving hole being knowingly drilled into the charge of the missed shot." Do you think that is a desirable rule?—I think so. Of course the other method would be to increase the distance.

17864. But there is no rule at present?—There is a rule as to six inches, is there not, somewhere—"and no hole shall be bored for a charge at a distance of less than six inches from any hole where the charge has missed fire."

17865. Do you think that is sufficient?—I do not think it is any too much; that might be a little increased. It might be a drawback in the blasting of the stuff; if you removed the hole any further you might not bring down the material.

17866. The object of this rule is that if there is a miss-fire you may not, in putting another shot, come across the shot you have already put in?—That is so.

17867. It is provided at present that it shall be not less than a certain distance?—Yes.

17868. The Lancashire rule is the one which I have read to you: "Before any shot is charged, its direction shall be marked out on the roof or other convenient place, so that in case of miss-fire the direction of the hole will be known, and prevent the relieving hole being knowingly drilled into the charge of the missed shot?"—I think that is quite a good rule.

17869. No shot must be unrammed, of course. Do you think that where there is a miss-fire, where the shot has not fired or is supposed to have miss-fired, some fixed time should be prescribed before anybody should be allowed to go to look at it?—I should be quite prepared, as I have said for a long time—I have never insisted upon it with my managers, but I have recommended it—that in places where there is the least doubt that a shot had not gone off, for instance, where there had been two shots fired and they have only heard one noise, they should withdraw the men for that day. I am quite prepared to lose the day in that place.

17870. You think it is very important that there should be some limit of time, and that a man should not wait simply until he thinks it is safe, but that some period, say an hour, should be fixed before anyone goes to the place and examines it?—Yes; and I would even go the length of saying that the men should not be allowed back in that place on that day.

17871. What is your view about the present Regulations? Do they prohibit more than one shot being fired at one time?—I have never read them in that way.

17872. You think they allow it?—Yes.

17873. Do you think that is desirable?—In underground work there is not very much necessity for it. We have it in sinking.

17874. But that might be met by a Special Rule. You might get an exception?—Of course there are cases where it might be an advantage to fire several shots together, but those cases do not occur to me. In our case in firing in the stone I have noticed the men firing two shots together to get a better effect.

17875. But, generally speaking, if you fire a number of shots together, you do not know that they have all gone

Digitized by Google

off, therefore, you think it would not be a hardship if the regulation was that only one shot should be fired at a time down below, and that there should be an interval before you went to the place if it did not fire?—Yes, I think that is so, certainly.

17876. You have already said that it is a matter for consideration whether the distance should not be extended for the watering?—Yes, around the shot—in dry and dusty mines.

17877. You agree that no shot should be fired in the haulage road except under the direction of the manager?—I agree with that. Of course I am speaking of in dry and dusty mines.

17878. And he, of course, would say what amount of explosive should be used, and what explosive should be used, and how many people should be there?—Yes, I said that the manager or overman should deal with that: the overman is quite a high enough official. It might not be quite convenient to get the manager, but the overman is always there, and if there was any special case he could consult the manager.

17879. He could give instructions as to how many people should go down and as to all the details with regard to firing the shot?—Yes.

17880. Under the Explosives Order, that is where permitted explosives only are used, the collier cannot fire his own shots?—No.

17881. A competent person has to be appointed to fire them?—That is so.

17882. And they have to be fired electrically?—Yes, or by other safe means. I think there are other alternatives.

17883. "No charge shall be fired except by means of an efficient electrical apparatus so enclosed so as to afford reasonable security against the ignition of inflammable gas, or by a permitted igniter fuse, as hereinafter defined"?—Yes.

17884. Now as to the detonator, that is the particular part of the shot-firing apparatus that you must take care of?—That is so.

17885. It is provided under the Explosives Order, in Section 4, that "Detonators shall not be used in or taken for the purpose of use into any mine unless the following conditions are observed:—(*a*) Detonators shall be under the control of the owner, agent, or manager of the mine, or some person or persons specially appointed in writing by the owner, agent, or manager for the purpose, and shall be issued only to shot-firers or other persons specially authorised by the owner, agent, or manager, in writing. (*b*) Shot-firers and other authorised persons shall keep all detonators issued to them until about to be used, in a securely locked case or box, separate from any other explosive." Can you conceive any other precaution which can be suggested with reference to detonators?—I think that is quite sufficient, as I have said before.

17886. You have been asked whether you see any reason why the man who uses these detonators, and who, until he uses them, keeps them in a box separate, should not also have the explosives?—I see no reason whatever.

17887. Before I leave the question of shot-firing, you said that you might strengthen the rules. I have suggested to you some few ways in which they could be strengthened: is there anything else that occurs to you with regard to it?—No, I think I have made the suggestion with regard to watering, that the watering should be extended. Otherwise I think that if these rules and the Home Office Orders are carried out they amply meet all that is necessary in Scotch mines.

17888. With reference to the dust, although it is not necessary in your mines that you should systematically remove this dust, do you think it is a desirable thing that dust generally should be removed and that accumulations of dust should be prevented? I will put it in two ways; do you consider that general, or do you consider that where the dust is of a dangerous character that should apply?—I do not think that where the dust is not dangerous there should be any compulsion to do it.

17889. Supposing these experiments were to establish the fact that some dust is not dangerous, then, of course, it would not have to be removed, but if they should establish that all dust is dangerous, would you favour a general regulation that accumulations of dust should be prevented?—Of dry dust?

17890. Yes, of dry dust?—Either that it should be removed or dealt with in some shape or form.

17891. With reference to dealing with it, you are in favour of watering?—Where it is possible, yes. I think watering is the best means of rendering the dust harmless.

17892. But would you approve of the German system, that the watering should be universally compulsory?—No, I should not agree with that at all.

17893. There are mines where watering would be impossible, from the natural condition of the mine?—Yes.

17894. Then, if you could not water on account of the natural condition of the mine, it would mean that you would have to have constructions of some kind in these zones which are spoken about—of masonry?—Yes.

17895. Are there cases in which in your view that could not be done?—It might be done, but there would be a great difficulty in maintaining them by reason of the crush. Supposing you had them in one seam and you were working another seam, either over it or below it, it would be very detrimental to those arched places—they would crush.

17896. The same would apply if you were preparing a zone for the purpose of clearing it from dust: if you could not maintain it for one purpose you could not maintain it for another?—Yes, the same would apply.

17897. You think that where wetting is possible in the natural condition of the roads that is the best method to adopt?—Yes, I think watering is the best thing where it is at all practicable.

17898. And where it is practicable you would approve of zones to be watered in order to prevent an explosion spreading where it was the misfortune to have an explosion?—Yes.

17899. With reference to the removal of dust, you wish to have information as to whether you can remove the dust from an ordinary road sufficiently to make what is left non-dangerous?—Yes, I think that point would require to be tested very carefully.

17900. If you could, then that is another way of dealing with it?—It is.

17901. Would you favour its being left to the manager of the mine to decide as to the way in which he would do it, considering the condition of his mine, whether he would do it by watering or by the removal of the dust?—Yes, so long as he made the mine safe.

17902. In cases where this could not be done, and where watering was impracticable, or you could not remove the dust, do you think there are any other precautions in regard to the conditions as to shot-firing besides those you have already suggested that would be desirable in order to secure safety from any shot or anything in connection with shot-firing?—Where you cannot adopt either watering or the zone system, or specially prepared places to remove the dust, I do not see any other precaution that you can take except to have safety lamps and to stop shot-firing.

17903. You think that where you cannot do either one or the other, you would have to stop shot-firing?—Yes.

17904. With reference to safety lamps, whether you are right or wrong you think that in the steep mines in Scotland introducing safety lamps would, it is true, be guarding you from a possible danger, but would be exposing you to almost a certain danger in another direction?—Yes, that is my view.

17905. You were asked questions with regard to the examination of shot firers. I do not know whether you agree with Mr. Smillie that the Mines Regulation Act requires a competent person to be in charge of a mine?—It requires a man with a certificate. I think I said in answer to Mr. Smillie that there were lots of men who had not certificates who might be as good as those who had.

17906. The manager is to be a person who has a certificate, and upon him there is the responsibility for seeing that everybody else does his duty?—Yes.

17907. And he is responsible directly for an offence committed by anybody about the place; under Section 50 of the Act the owner, agent or manager is responsible for every offence committed. That section provides that: "Every person who contravenes or does not comply with any of the general rules in this Act shall be guilty of an offence against this Act; and in the event of any contravention of or non-compliance with any of the said general rules in the case of any mine to which this Act applies, by any person whomsoever, the owner, agent and manager shall each be guilty of an offence against this Act, unless he proves that he had taken all reasonable means, by publishing and to the best of his power enforcing the said

Digitized by Google

Mr. J. T. Forgie.

18 April 1907

rules as regulations for the working of the mine, to prevent such contravention or non-compliance" ?—Yes, unless he proves it.

17908. It is for the manager, who is placed there under his certificate, to see that he gets competent people to discharge the duties ?—That is so.

17909. If he fails to do so he is answerable himself ?—That is so.

17910. Do you think that for a shot-lighter and the like he is quite able to find out a man who is competent without being under the necessity of being confined to a class who hold certificates ?—Yes, he is quite able to do that.

17911. The general conclusion which you come to upon the question of dust, I understand to be that you want more information as to whether the difference can be made between dust which is dangerous and dust which is not dangerous ?—That is so.

17912. And until that information is obtainable you could not commit yourself to any general view as to what should be done with reference to all dust ?—That is so.

17913. But with reference to dangerous dust, you would favour a provision being made to prevent its accumulating, and that watered zones where possible should be provided in order to prevent the disaster extending, if there happens to be an explosion; that is your view ?—That is so.

17914. (*Mr. Wm. Abraham.*) I think you have told us that you have had no practical experience yourself in dry and dusty mines ?—None whatever.

17915. So that the recommendations which you would make for dry and dusty mines are simply as a matter of opinion ?—Yes, a matter of opinion. Of course, we have had one of our mines declared a dusty mine, as you will see from my notes of evidence.

17916. But you are not the manager of that mine ?—Yes, I am the manager of that mine. It is not the Denny mine, but if you read my notes of evidence you will see that is so; that mine, in my opinion, was not dusty, but the inspector declared that it was dusty. We have a slight provision for watering by syringes in that mine. That is my only experience of dust.

17917. Could you tell us where the mines are in which watering would be possible ?—You mean in Scotland ?

17918. Anywhere ?—Mines with hard roofs or hard pavements—stone roofs or stone pavements—I do not think would suffer much, but if you have anything in the nature of fireclay or soft blaize with a small proportion of lime in it, as exists in Scotland, this watering would be very detrimental.

17919. Have you had any experience of that possibility at all ?—Yes, we have had experience of it in the splint coal working in my district. We have a very bad pavement, and working to the dip we had practically to give up the working of that coal, and we are leaving it now to be worked from a deep pit at some future time.

17920. What was the reason—water ?—Yes, water: it swells so that you could not keep open the space in the roads.

17921. Was it a wet mine ?—No, there was not much water in it: I do not suppose there was more than 100 gallons a minute.

17922. Were those conditions created by watering ?—Not by watering, but by the natural water.

17923. But you would require an immense amount of watering to bring about the same effect as natural watering ?—No, not so very much. That was only 100 gallons per minute spread over a very large area, and if you came to water a mine which was very dusty I question whether you would require very much less than about 100 gallons a minute.

17924. But is there any danger from the dangerous dust which we are speaking of in that class of mine. Is not that the class of mine in which you have proved already that the dust is not of a dangerously explosive character ?—Yes, but you could get another mine with a similar roof and similar pavement which might be dry and dusty: that fireclay might quite well be dry, and then if you watered that mine you would get the same conditions of roof and pavement as I am telling you of.

17925. But the point now is this: do you know of any mine of that condition where there is this highly dangerous dust existing ?—I do not myself personally know of any, but I have heard of one or two in England.

17926. So have we heard of that until we come to put this question ?—I am in the happy position of being able to say that we do not have dusty mines in Scotland.

17927. Therefore, this again, is simply a matter of opinion not based upon experience ?—It is not a matter of opinion as to the damage that water would do on certain pavements or on certain roads.

17928. But not as to a mine being artificially wet ?—It would have the same results.

17929. But pardon me, you have not given us any proofs of that result from artificial watering ?—I do not see that artificial watering would have any different effect from natural watering.

17930. But is it reasonable to think that where a coating of dry dust lies over the pavement, as you say, that pavement ought to be soaked with water in the same sense as it is soaked by natural water, to bring about the same result ?—I am afraid the watering required to render dust safe or harmless would be very much more than simply damping it. I think the German system proves that, because they are going in for a pretty extensive system of watering, not by the sprays which they started with, but by hose pipes running on water in very considerable quantities. That is exactly the sort of thing that would damage the roofs and pavements I am referring to.

17931. But you have said that you have not seen the same condition of things yourself effected by artificial watering as was the case where the nature of the seam was that it was wet ?—If you wish me to say this I will say so, that I have no experience of a dusty mine with a bad roof and pavement being watered and being injured thereby: that is the answer which you wish, I believe.

17932. Again, have you had any experience, or do you know of any mine where the introduction of safety lamps instead of naked lights has been the means of increasing accidents ?—I could not give it in figures, but I think I stated that Mr. Mowat, who is with me here representing the Scottish Coalowners, can give you a case in point.

17933. So far as you know that fact depends upon Mr. Mowat ?—Yes: but I may say this, that the mines which are wrought with safety lamps in Scotland are flat, and the tendency for the use of lamps to increase other classes of accidents would not be so great in them as it would be in the present mines that are wrought with open lights, which are steeper.

17934. Then if Mines Inspectors and Managers were to tell you that the result has been otherwise, and that the result has been to decrease them instead of increasing them, you think that they would be wrong ?—I have my own opinion. I give my own experience as to whether it has decreased them: I know for a fact that it has not decreased them in our mines. We have introduced safety lamps after having had naked lights, and we have certainly not decreased the number of accidents.

17935. With regard to those small explosions which you call "ignitions of gas," is the practice of brushing out gas still in vogue ?—Do you mean wafting it out with a coat, say ?

17936. Yes ?—No, that is very little done. They sometimes put up what they call a hurdle screen.

17937. I thought from the reference which you made to that point in your evidence this morning having regard to the fact that it created no danger, that the condition of things need not be improved in that respect ?—Well, I do not exactly wish to give that impression. I am always willing to do anything, and I think all the coal masters of Scotland are willing to do anything which it could be clearly shown to them would be an improvement or would tend towards a reduction of the loss of life. But what we want to guard against, especially in these cases of the steep mines in Scotland, is not to introduce anything which may reduce the accidents from loss of life from one certain cause and thereby increase them in another respect. It would be a false step to take probably, especially if you did increase them more than you reduced them: that is our point. But I am with you in this, that we ought to do anything to try and reduce the danger in mines: I think we are all with you in respect of that.

17938. But the number of these smaller explosions or ignitions of gas in Scotland does warrant something being done to reduce them, or to make them impossible ?—Yes, I quite admit that, and anything which you can show us is reasonably practicable we will endeavour to carry out.

17939. I think you said this morning that it was possible that one of these little pockets of gas (you used another expression for it, but it means the same thing) in the roof of a man's working place might have gathered there and accumulated after the fireman had been round ?—Yes.

17940. Is not that against the natural effect of the man

Digitized by Google

being there at work? Is it not the fact that his being there working and fussing about has the effect of producing some movement of air which would not be so produced if he were not there?—He is sometimes at the face of the brushing, and sometimes he is not. In the morning he is not inclined to be there, because he has to start work at his face. I do not think that has much to do with it; but the fact that the fireman goes round in the morning and examines it and finds it clear you must accept as the statement.

17941. But it happens sometimes that the fireman has been found burnt a couple of hours after that?—Yes.

17942. Supposing the man found that there was a large pocket of gas an hour or two after he had commenced, what would be the means which he could take to clear his stall from that gas?—He would either put up a hurdle screen or take some other means of clearing it out.

17943. (*Chairman.*) What is a hurdle screen?—I will describe it. (*The Witness made a sketch and described to the Chairman.*)

17944. (*Mr. Wm. Abraham.*) Does the man himself do that?—No, the fireman. The man may do it if he chooses, but as a rule he asks the fireman to do it.

17945. And that is done while they are at work?—That is done while they are at work. Of course there is a hurdle screen put up in a great many cases.

17946. We call it putting up a canvas door, or something of that kind; I know exactly what you mean. But is that allowed to be done while the men are at work in a district?—We generally find these small accumulations in one place. It is not a general thing to find gas all over the place. It is generally found at some place, specially going into fast working; and as a rule this screen would be up pretty constantly, and it would not be a temporary matter to be used for a day or for an hour, but would be put there and constantly carried into the face in that special place. With regard to when we put it up I could hardly tell you, but it might well be put up during the day.

17947. You would not find fault with it if it was put up during the day?—If the gas was there of course the fireman should put the workmen out before he puts it up.

17948. Is that course taken?—Yes, it is so.

17949. Then how do men get burnt?—Well, of course that is an accident.

17950. There are a number of these accidents in which men are burnt, a large number being burnt and a few killed, as you say. There are a number of such accidents which, had it not been for the Act of Parliament compelling them to be reported, you think it would be unnecessary to have reported?—The accidents are so trifling; there are far more serious accidents which are not cases of explosions, and which are not reported.

17951. And you would not have reported these cases had it not been for the Act of Parliament?—Yes, I quite admit that frankly.

17952. (*Chairman.*) I do not quite understand that. How far do you consider it your duty to report accidents which do not carry with them any serious personal injury? What is the rule under which you act?—I do not know that there is any rule, but the Act stipulates that.

17953. What does the Act say?—There is a Notice of Accidents Act in force now which prescribes very clearly what we have to report, but hitherto it has been very much left to our own judgment.

17954. Under the last Act you would know much more certainly what you ought to report and what you ought not to report?—Yes.

17955. But apparently you consider now that you are bound to report accidents which are due to explosions, and which you would not report if they were due to any other cause?—Yes; that is stipulated.

17956. (*Mr. Wm. Abraham.*) Those cases would not be reported had it not been for that stipulation?—That is so.

17957. (*Mr. Cunynghame.*) Do you blast coal in your mine?—Yes.

17958. What explosive do you use?—In the open-light pits we use to a certain extent gunpowder, but in the safety-lamp pits the permitted explosives which we use are carbonite and saxonite.

17959. Carbonite is a good explosive. How do the men provide the gunpowder in the cases in which they use gunpowder?—They buy it for themselves.

17960. From whom do they buy it?—They buy it wherever they choose—from grocers and people who have licences.

17961. It has been represented to us very often that accidents happen to children and all sorts of people by reason of the taking home of small cartridges of gunpowder. What do you think of that practice?—I think that we as coalmasters and managers would be quite in agreement with you in making the employers supply the explosives at the pit-head.

17962. You are aware, I suppose, of the law that when an employer supplies explosives, he is not permitted to charge a price which is greater than the total cost to him of the explosive. He may include the expense of the storage of it, but he is not entitled to make any profit out of it?—Yes.

17963. That is not the provision under the old Truck Act of 1831?—No.

17964. You are aware that that is provided by the more recent Truck Act?—Yes. I do not think employers would wish to make any profit.

17965. Do you think there would be any difficulty on the part of the men, so far as you know, by reason of their being restricted from buying the gunpowder at the nearest ironmonger's shop? Can you think of any advantage which the men might get from their being able to buy it in that way?—The only advantage they can get from it is this, that in some cases they get what they call a "dividend" at the end of the year, but then the price is, I suppose, put up to start with.

17966. Yes, of course. You would probably let it be supplied to the men from you at cheaper rates than the ironmonger would?—Quite as cheap at all events; I should not like to say cheaper, but as cheap.

17967. Then there would be no reasonable opposition, so far as you can make out, on behalf of the men to a regulation against taking this stuff home and keeping it there?—I do not think so. I think it would be to their advantage, so far as they are concerned, because in some cases they have lost their own children by that practice.

17968. Have you known any accidents occur through men taking explosives home?—I have known one or two.

17969. Will you give me the circumstances of one such case, if you can remember them?—I remember one case of an accident to a child about six years of age. This happened to be a case of a detonator. The man should not have had detonators in his possession, and how he came to have one I cannot tell you, but he had this detonator, and it was taken home and the child got hold of it, and it had a pin and was pricking at it inside. There was a little sawdust in the detonator arising from the fact that they are packed in sawdust, and all the sawdust had not come out. The detonator went off, and the result was that it knocked, I think, four of the child's fingers off.

17970. You are aware that every year there is a certain toll of accidents (it is not a large number fortunately) of this character?—Yes. Then there is always the danger of heating explosives if they have them at home. But in our case we supply the high explosives at the colliery. I should like to make one statement regarding the question of explosives; probably it does not apply here, but the difficulty of getting licensed premises at the colliery would be a very great one with regard to the question of supplying the whole of the explosives.

17971. But that difficulty you are aware might be removed by the explosives authority, which is the Home Office?—Yes, but I mean under the circumstances we are speaking of.

17972. I am suggesting to you that where it is necessary to be done it should be done?—Yes.

17973. (*Mr. Smillie.*) I think really the only serious opposition would be on the part of large contractors. Do contractors as you are aware buy their explosives in very large quantities?—They simply get them from us also.

17974. They tell me that they can get them 25 per cent. cheaper from other people?—In our case all our contractors must buy the explosive which we stipulate, and therefore they cannot buy it any cheaper than we can.

17975. (*Mr. Cunynghame.*) I am not concerned so much with the question of cheapness. The difficulty could be met by proper rules being made so as to take away all hardship?—But I mean to say the danger is this: if you allow the workman to buy explosives outside the colliery, you run the risk, unless you examine every cartridge, of things being used which you do not wish to have used, and therefore when you supply them and compel the workman to use the explosive supplied by you, he has power to audit

Digitized by Google

Mr. J. T. Forgie.
18 April 1907

your books and see that you make no profit out of it, and then he will use the explosive you supply, and which you wish to have used.

17976. (*Mr. Smillie.*) Could he not do the same thing whether you supplied them or not. Could he not take them down with him?—No.

17977. Well, if he is prepared to cheat you in one way, he could in another?—He could take it under his coat or concealed in some way like that, but there would be less chance of that happening.

17978. (*Mr. Cunynghame.*) Then it looks as if it would be better that contractors should not be at liberty to buy their own explosives?—In our collieries we make the contractors take our explosives—that is, permitted explosives.

17979. Then, again, you are prevented from making any profit out of anything which you supply, so that there would be no profit made thereby?—That is so.

Mr. DAVID MARR MOWAT, called and examined

Mr. D. M. Mowat.

STATEMENT OF WITNESS.

17979A. I am a Mining Engineer and Certificated Colliery Manager, a Vice-President of the Mining Institute of Scotland, and am General Manager of the Iron Works and Collieries of the Summerlee Iron Company, Limited, and have been connected with mines for about 29 years. I am also an examiner for certificates of competency as Colliery Managers in the West of Scotland District.

I appear here along with Mr. J. T. Forgie on behalf of the Coal Owners of Scotland.

The output of coal at the Collieries belonging to my Company is fully a million tons per annum, besides ironstone and fireclay.

I have had experience of a coal dust explosion in one of the collieries under my charge, which arose from a blown-out shot on a haulage road.

The Coal Owners of Scotland are fully alive to the danger of the presence of certain kinds of dust in mines.

(1) There is no doubt that if the danger arising from coal dust was eliminated from our mines, deaths by explosion would be few in number and would not call for any drastic remedies which would probably cause an increase in the death rate instead of a reduction.

(2) Our mines are fortunately comparatively free from dust, but in view of the fact that there have undoubtedly been coal dust explosions in Scotland, we wish to adopt such precautions as will prevent these occurring in future so far as possible. While that is so, we are averse to taking precautionary measures at great expense when such are not called for, and it appears to us that further investigation should take place in order to ascertain what kinds of dust are dangerous and whether it is a certain chemical, physical or mechanical condition, or a combination of these which causes the danger. We think this is most important, as already difficulties have arisen as to the meaning of the phrase "dry and dusty" which appears in the Coal Mines Act and in the Explosives Orders.

(3) We would, therefore, urge on the Home Office, the necessity of at once establishing an experimental station for the purpose of carrying out tests, on as natural a scale as possible, so that the condition of any dust may be ascertained. Presently if a question arises as to whether a dust is dangerous or not, there are no means by which it can be ascertained.

(4) There is no doubt that it is almost entirely on haulage roads where dust is to be found of such a nature as to be really dangerous, and we would therefore urge that any regulations or legislation with reference to dust should be confined to guarding against that danger.

(5) Where haulage roads can be thoroughly watered, that is the most effective way of preventing an explosion, and of confining an explosion when such does occur to a comparatively limited area. But inasmuch as there are collieries where thorough watering would cause great danger, trouble and expense, through falls of roof and sides and heaving of pavement, alternative methods of treatment should be allowed such as removal of the dust, sprinkling with salt or calcium chloride, or the creation of dustless zones.

(6) In cases where none of these methods are applicable, exemption should be granted on condition that certain regulations as to lamps and shot-firing should be observed. Most of the danger arising from the presence of dust has already been removed by the application of the Explosives Orders, and we are strongly of opinion that such a proposal as universal watering of mines need not be considered. We have no doubt that any regulation to that effect would be followed by an increase in the number of accidents.

(7) The phrase "dry and dusty" in the Coal Mines Regulation Acts and in the Explosives Orders should be modified by the addition of the words "with dust which would create or extend an explosion."

(8) With regard to the shot-firing between shifts, it would be absolutely impossible to work many collieries if shot-firing were prohibited excepting between the shifts.

(9) It is also unnecessary on the ground of safety that such a regulation should be enforced in Scotch mines. We are aware that this is being done in some collieries in other districts, but the value of the coal at the pit mouth in Scotland is lower than in any other mining district in Great Britain, so that no regulations which would increase the cost of raising the coal should be imposed, unless these are absolutely necessary for the safety of the persons employed.

17980. (*Chairman.*) You are a Mining Engineer, a Certificated Colliery Manager, a Vice-President of the Mining Institute of Scotland, and you are General Manager of the Ironworks and Collieries of the Summerlee Iron Co., Limited, and you have been connected with mines for about 29 years. Have you been exclusively in Scotland, or do you know anything about other mines?—I have been exclusively in Scotland. I have been in mines in England, but not employed in them.

17981. You are an Examiner for Certificates of Competency as Colliery Managers in the West of Scotland District, and you speak on behalf of the coalowners of Scotland, with Mr. Forgie. You have had experience of a coal dust explosion which arose from a blown-out shot on a haulage road. What was that accident?—That was at Drumpeller Colliery, Coatbridge. There is a special Report by Mr. Ronaldson and Mr. Hall.

17982. Have you anything you would like to say about that accident?—Yes. It arose out of a blown-out shot. That shot was to be fired with roburite. The first Explosive Order was issued on 1st January, 1898, and the accident happened on the 28th January, 1898. Before the end of the year 1897 we had been experimenting with roburite with a view to falling in with the Order when it came into force. We had adopted roburite as being what we thought the likeliest explosive for that purpose, and this was the first shot we had to fire on a dusty main road under the Explosives Order, and the men who fired it fired with powder. There is one thing where I think the inspectors fell into error, but I do not know whether it has a material effect on the question. I will draw your attention to it, and you can judge for yourselves. Mr. Ronaldson and Mr. Hall found that it was not likely the manager had told the men to use that special explosive.

17983. They thought the men had not been told?—Yes.

17984. You say they were told?—Yes. I will show you where it is quite clear that they were.

17985. "We believe that it was intended by the manager that a permitted explosive (roburite) should be used, but that he failed to give the requisite instructions and to make such regulations as would ensure its use." You say that is not so?—Yes. I will show you in a moment. One of the sisters of the deceased was examined. This is a thing we did not know until the enquiry—

17986. That was not at the enquiry?—Yes, it was at the enquiry. It is in the same book. On page 20, Janet Anderson said: "The deceased, Thomas Ward, was my

Digitized by Google

son: he was 35 years of age, unmarried. His father's name was James Ward, a miner. He was buried in old Monkland Churchyard on the 1st of February. He was a brusher, and used a considerable quantity of gunpowder. I was in the habit of going to Ramsey's, the grocer, for gunpowder: he used about 14 lbs. a week. I recollect shortly before one o'clock on the day of the explosion that Thomas asked me to go for 4½ lbs. of gunpowder. I went and got that and brought it to him, and he took it with him in his oxter"—that was under his arm—"that night to the pit. On the day of the explosion"—that was before he had gone to the pit—"he told me he had to go earlier to the pit because he had to try a new explosive." I think it is absolutely clear that the manager must have given that instruction the day before. I do not know how the inspectors fell into that error. We did not see it until after it was published.

17987. In the last paragraph they say: "The lesson which this explosion at Drumpeller Colliery teaches is that wherever it is necessary to use permitted explosives in a seam the precaution should extend to the whole seam." I do not quite understand that. Would not the precaution necessarily extend to the whole seam?—No. This was a shot being fired in a main haulage road.

17988. You mean a shot in the face, or anywhere else?—It was a shot fired between the shifts in a main haulage road.

17989. Do they mean wherever the shot takes place, whether in the main haulage road or the face, or the stone drift?—I expect they would mean that, so that the men would not have anything else but a permitted explosive to use. In this case they used powder. The Home Office had the scrapings of the shothole analysed, and that is given in evidence by the Home Office expert.

17990. I understand now the Order is amended, and this recommendation of Mr. Ronaldson and Mr. Hall has been put into the Explosives Order?—This was the first Order, and it had just come into force.

17991. In the Second Order that would be so, wherever it is necessary to use permitted explosives the precaution should extend to the whole seam. You say the coal-owners of Scotland are fully alive to the danger of the presence of certain kinds of dust in mines. Do you think the men are fully alive to it or not?—I think they are getting more alive to it.

17992. Do you take any precautions to ensure that they should be alive to it? Do you tell them about it?—The officials in the collieries are pretty much alive to it.

17993. Do the officials try and instruct the men in the matter? Do you think they talk to them?—I believe they do. Roadsmen and firemen talk to men using explosives.

17994. You have no general principles which you go upon in the way of instructing the men. You do not call them up every two or three months and instruct them in the danger of coal dust, or anything of that sort?—No.

17995. Do you think it would be any good if you tried to get up lectures which the men might attend on the subject of coal dust? Do you think they would come?—My impression is that the men who come in contact with dangerous coal dust are few. It does not apply to the general body of miners. It is more particularly applied to repairers, men who are repairing roads.

17996. You think it does not matter that the greater part of the miners are ignorant about coal dust?—I do not think the general miners are working in a place where there is any dangerous dust in Scotland.

17997. There are very few working where it is dangerous?—Yes.

17998. You think experiments ought to be conducted with a view to finding out what dusts are dangerous, and we are going to conduct those experiments. Have you anything you would like to say upon that yourself, as to your experience as to what makes dust dangerous or not dangerous?—I knew Drumpeller Colliery where that explosion took place when it was working very well. I was also in Udston Colliery on the night of the explosion, and a fact that impressed itself upon me was that these dusts had the effect, when you got yourself dirty with them, of sticking to the skin, and that there was something of a greasy nature in the dust itself, or the fineness of it. It would not wash off. That is not common to most of the so-called dusts in Scotland.

17999. You think that would be one of the tests as to whether a dust would be explosive or not?—It is a fact which impressed itself upon me.

18000. When it sticks to the skin you think that is an indication that it is dangerous?—In this pit, if you went down the pit and walked about for an hour or two and came up dirty and waited till you were cool, you would have to wash two or three times before you could get it off. That does not apply to most of the dust.

18001. You say it is almost entirely on the haulage roads where the dust is of such a nature as to be really dangerous? I suppose where horse haulage is used the dust would not be so dangerous, it would be mixed?—By the horses feet and droppings, and so on.

18002. You mean where the haulage is conducted mechanically?—Yes.

18003. You do not think close to the working face there would be much danger?—None at all in Scotland.

18004. You do not think so?—I do not think so.

18005. You think that the danger is entirely in the haulage roads, and that any rules and regulations that we might suggest should have entire reference to the question of dust on haulage roads and nowhere else?—Yes.

18006. You say where haulage roads can be thoroughly watered that it is the best way of preventing an explosion and of confining an explosion, when such does occur, to a comparatively limited area, but that sometimes you must have alternative methods of treatment, such as removal of the dust, sprinkling salt or calcium chloride, or the creation of dustless zones. You consider it is very desirable, where the strata admit of it, that you should have a thorough watering of mines?—Yes, after it is proved that the dust is a dangerous dust. I do not think that all dusts are dangerous.

18007. You think there may be such a thing as a dusty mine and fine dust where it would not be necessary to take any precautions at all?—Yes.

18008. That you would be willing to leave to the Experimental Committee?—Yes.

18009. Then you deal with zones. I suppose you have not conducted any experiments with a view to finding out how long a zone would be required to stop an explosion?—No.

18010. How would you remove the dust? Do you propose to remove it dry or after damping it?—My impression is where it could be watered you could remove it or render it harmless. I do not think it could be removed absolutely, if a dangerous dust, to make it free from danger.

18011. Not even if you had archways?—If it was done every day or oftener than every day.

18012. Do you think it could be removed dry?—I do not think it could unless it could be done by a vacuum cleaner. I do not think it could be done by sweeping it up or shovelling into tubs.

18013. You have no idea from your experience what amount of dust would be likely to propagate an explosion?—No.

18014. You suggest where watering is not applicable that certain regulations as to lamps and shot-firing should be observed?—Yes.

18015. Do you think safety lamps are sufficiently used in Scotland?—I think they are.

18016. Because there are a very great number of accidents from explosions in Scotland?—Some of them are so very slight that the man is working the next day.

18017. But there are a great many deaths also?—Not very many.

18018. Fatal accidents are higher than in all the districts put together?—No, that is not so.

18019. Nearly 100 in the Scottish districts. In the other districts there would be about 600. I see I am mistaken as to that. You are not so bad as I thought?—I have some figures as to that, but I did not expect to be called on to-day.

18020. At all events there are a considerable number. You do not compare favourably with other districts even with regard to deaths, let alone injuries?—We are below the average a good bit, and if you take it in conjunction with falls of roof and hutch accidents, we are much lower than the average of all the districts.

18021. As regards explosions you have 74 in your two Scottish districts against 183 in all the other districts—all together; that is to say, you have 74 in Scotland and about 109 in all the other districts?—Persons killed I am referring to.

Digitized by Google

Mr. D. M. Mowat.

18 April 1907

18022. There are a very considerable number of accidents in Scotland, almost entirely due to naked lights, I understand?—Yes.

18023. You say in face of that that you do not think it is desirable that naked lights should be decreased?—I think it is very undesirable.

18024. Why?—Because they would increase the number of accidents.

18025. Why?—I have some figures which I intend placing before you at a later date. They are not quite ready. We have a colliery of a considerable size with an output of 280,000 tons of coal a year, and over seven years one-half of it, worked by one pit, is all naked lights and the other half of it, worked by another pit, is all safety lamps. The colliery is all under one management working the same seams, and if there is any advantage at all it is in the pit worked by safety lamps, because it is a flat working compared with the other one, which is steeper, and there are 25 per cent. less accidents in the naked lights half of the colliery per 1,000,000 tons of coal than in the other half worked by safety lamps.

18026. What kind of accidents?—Accidents of every kind, every case reported in connection with the Compensation Act since its beginning.

18027. Is there nothing to explain that except the circumstance that one part of the colliery is worked by naked lights and the other part by safety lamps?—No, there is no other cause.

18028. There is no other difference?—There is no other difference, and if you look into Mr. Delevingne's figures you will find that with regard to accidents on haulage roads and accidents by hutches generally we stand much lower on an average than the whole of Britain, and falls of roof as well.

18029. I understand that your contention is that accidents on haulage roads would be a good deal increased?—With the use of safety lamps. Yes.

18030. Owing to the safety lamps going out and the men being left in the dark?—And having one hand carrying his lamp, and only one hand to save himself.

18031. Cannot he put his lamp up somewhere?—Not if he is travelling on a haulage road.

18032. Supposing you had lights on these sets as they went along the haulage road, would not that give a man a better indication than he has at present where the danger is coming from? He might not know which way the set was coming from; he would only hear a noise?—Nearly all our haulage is endless rope with single tubs, and it would mean thousands of lamps to have one on each tub.

18033-35. You say that certain regulations as to lamps should be observed. What regulations would you suggest?—I suggest this: if you have a haulage road which has been found by experiment with dust to contain a dangerous dust, and if it is found by experiment that you cannot remove that dust so as to prevent the extension of the explosion absolutely, or cannot water it on account of the nature of the strata, then I say you must prevent ignition of gas or a blown-out shot.

18036. You say that certain regulations as to lamps and shot-firing should be observed?—I say in a pit of that kind, a pit where that existed and you could not stop it, you must prevent an ignition of gas by the use of the best lamps possible. I would not use a naked light in that pit on any account whatever.

18037. Your suggestion as to lamps comes to this, that the best kind of lamp should be used?—Of safety lamps.

18038. I mean safety lamps should be used. That is the only suggestion you make with regard to safety lamps?—I say that, assuming the danger of igniting gas was very little; you must not take any risk at all with such haulage roads.

18039. You do not suggest any further regulations as to safety lamps as long as you have the best. Then you say that regulations as to shot-firing should be observed; you mean as regards watering, and so on?—Yes; and in a mine of that kind a shot of that kind should be fired under the supervision of an official something more than a shot-firer.

18040. In mines of that description you would not be content that the shot should be fired by the authorised shot-firer; you say some official such as the under-manager or somebody above the shot-firer, should be present when the shot was fired?—Perhaps not when the shot was fired, but no shot should be fired without the place being examined by the under-manager or an official such as him, and his consent given that it should be fired.

18041. You do not mean that he should be present at the time when the shot is fired, or any superior official than the fireman?—If such a thing happened once a year, or once a month, I would have no objection, but in some cases where you have a heaving pavement and the road requires frequent repair, the under-manager might require to be in the pit every night, and you could not work him night and day.

18042. Do you suggest it should be necessary that one person should take the detonator and another person should take the shot—the cartridge?—I do not think so. What I have in mind is this. In a pit where you have a haulage road which was avowedly dangerous, and which you could not water or remove the dust from, I do not think there is any precaution that could be taken in firing a shot that should not be taken. First of all, the manager or under-manager should give his sanction, and the shot-firer in the ordinary way should be present, and if it was not possible to water it, it should be done between the shifts, when nobody was in the pit except the men firing the shot, and the best explosive used.

18043. You suggest that a General Rule should be passed, or that it should be made a Special Rule to apply all over the country, that there should be no shot-firing except between shifts on main haulage roads in a mine which is dry and dusty?—Where not treated by water.

18044. You say in such cases it should be only between the shifts?—Yes.

18045. There might be made a General Rule to that effect. You can always water 20 yards round a shot; you are bound to do so by Act of Parliament in a dry and dusty mine, or do you only water the floor?—I am assuming a case where you cannot water. If you can water 20 yards each side of a shot you can water a zone.

18046. Do you think that it is compliance with the Act? Some people think if you water 20 yards along the floor it is compliance with the Act, and you may leave the roof and sides dry and dusty?—I do not think that.

18047. That ought not to be allowed?—That ought not to be allowed.

18048. If you cannot water roof and sides the disability should apply, and you should not be able to fire a shot except when the men are out of the mine?—I would apply the second section of General Rule 12.

18049. You would not apply it where you could water round the roof, sides and everything?—No.

18050. You say most of the danger arising from the presence of dust has already been removed by the application of the Explosive Orders. What sort of dangers are not removed by the application of the Explosives Orders? Supposing the Explosives Orders are adhered to in every respect, you still say there are dangers, because you say most of the dangers arising from the presence of dust have already been removed by the application of the Explosives Order?—I do not think of any; I have no other in my mind. I think the dangers are really all removed.

18051. You have no suggestion about adding anything to those Orders?—No.

18052. To come back to my point about the cartridge and the detonator. You do not think that there is any objection to the same man taking the cartridge and the detonator?—Do you mean in every case, in the case of every shot in a pit, or any special shot fired in a haulage road?

18053. Take any special shot fired in a haulage road?—I would have no objection to a rule that the shot-firer should charge such a shot as well as fire it.

18054. My point is should there be somebody besides the shot-firer, because if it happens he does not do his duty and you had somebody else, even a working collier to go down with the shot-firer, he might prevent the shot-firer from neglecting his duty. That is the suggestion we make, not that things would not be right if the men did as they were told and as they ought to do under the Order, but we find sometimes even shot-firers do not do what they ought to do, and the point is if you had two men to fire every shot, at all events in the main haulage roads, there is less likelihood of the rules being contravened, because one man is a check on the other?—In any case of a shot-firer there are more than two men present, the probability is that there are two or three men working at that place, and the shot-firer comes to fire the shot when ready.

Digitized by Google

18055. If the men were working they would not notice what he was about, but if a man accompanies him with the explosive and the man who has the explosive hands him it, and they are together, he sees the shot-firer does his duty, or he may see ?—I think that would be labouring it beyond any reasonable requirement.

18056. You do not agree that the universal watering of mines is followed by a number of accidents; I suppose you mean falls of roof and sides ?—Yes.

18057. You say the words "dry and dusty" should only be attached to a mine where the dust is such that it would create or extend an explosion. You consider as the result of these experiments we are about to make that we should very carefully grade the mines and not include a mine under "dry and dusty" unless the dust was of such a nature as was proved by analysis and experiment to be capable of carrying an explosion ?—Yes, that is so.

18058. You say you are not in favour of shot-firing in haulage roads being prohibited except between the shifts; it would be an absolute impossibility to do so in all cases ?—Yes.

18059. Although you are aware that this has been done in collieries in some other districts.

(*Mr. Cunynghame.*) Apparently you are of opinion that shot-firing between the shifts could not be worked ?

(*Witness.*) Not as a general rule.

18061. Do you work it at your place ?—No.

18062. What is the reason shot-firing between shifts is really an impossibility ?—For instance, I have one colliery in mind where the brusher fires most of the shots. I do not know what the English expression is.

(*Mr. Smillie.*) A "ripper."

(*Witness.*) Making the road at the face he goes in and first fires one shot and then another shot to complete his shift. One shot would not brush the road, it requires two shots, even though you prepared the shot the night before and fired it. That only does the man half his time.

18064. (*Mr. Cunynghame.*) I have not followed you ?—A man goes into a road to rip it.

18065. During a shift ?—Yes. The present system is this: he goes in and bores a hole, fires it and redds it, that is, clears it away; he bores another hole, fires it and clears it away. That is his shift. In other cases where only one shot was required to give as much stuff as a shift, the shot could be bored the night before, fired between shifts and redd during the following shift.

18066. You mean in case you could not begin making the second hole until you had already fired and cleared away the stuff from the first ?—Yes.

18067. That is where two holes are in that particular sort of position it could not be done ?—One fired after the other.

18068. That is very seldom ?—No, that is quite common.

18069. Could not the holes be made in such a way that they could be fired one after the other, even though the stuff had not been cleared away ?—One clears off so much and the next is bored after it.

18070. Still, could not that man go in and do his work and one or two others with him to clear as a separate shift on their own between the shifts of the ordinary workmen ? Supposing you had a day shift of so many hours, why could you not, during the interval of that shift—the intervals of the shifts would be eight hours ?—Nothing like that.

18071. What is the interval of the shifts ?—Perhaps three or four hours.

18072. Take three or four hours as the intervals of the shifts. Would not three or four hours be enough to blast a hole, clear the stuff away, bore another, blast it and clear that away ?—No.

18073. If you had enough men ?—No.

18074. That would be done during the ordinary day shift ?—That is during the ripping shift. There are no colliers employed during that shift.

18075. It is between ?—That is during the ripping shift.

18076. You are doing already the very thing we are speaking of. We should call that blasting between shifts ?—Most of the pits in Scotland are only single shifted and we would not say that the ripping shift is between shifts.

18077. That ripping would go on when the men were not in the pit getting the coal ?—There are a good many men in the pit then.

18078. It could be managed not to go on when any men were getting coal in the pit: it could be managed in three hours ?—No.

18079. The time would not be long enough ?—These men work eight or ten hours.

18080. Does it take eight or ten hours to do two holes and clear up ?—And one hole in some cases. A brusher's shift is about eight or ten hours.

18081. I suppose if the Legislature were to enact an eight hours' day, that would make some difference to the blasting ?—A serious difference.

18082. Make it more possible ?—More difficult.

18083. I should have thought it would make the interval longer ?—No, it does not. If the brusher is required to go down and come up in eight hours——.

18084. We have no right to assume how many hours they are going to be. It seems to give a longer time to blast between shifts ?—A collier can work as long or as short as he pleases, and go home and leave his place in good order or bad order, and it hurts nobody; nobody follows him. But if a brusher fires a shot more than he is able to redd, and he redds part and goes home with his coat on at eight hours, and a collier comes out and cannot get started——.

18085. I was not arguing the eight hours' question. I was asking you how far the work done during shifts could be done out of shifts. It seems to me that a good deal could ?—If you argue the ripper's shift is not a shift.

18086. I do. It is not a shift in my meaning. I may be using the words wrongly ?—In Scotland most of the ripping is done out of shifts in that sense.

18087. That is a very safe system to adopt, to have a ripping shift as much as possible. Do you mean shot-firing in the coal ?—No.

(*Mr. Cunynghame.*) He calls a "shift" a "ripping shift." That is the explanation. I thought he meant a coal-getting shift.

18088. (*Sir Lindsay Wood.*) There are two shifts—one coal-getting shift, and one ripping shift ?—That is so.

(*Sir Lindsay Wood.*) If you distinguish the shifts yon then get at his meaning.

(*Mr. Cunynghame.*) It is clear now what the Witness meant.

(*Witness.*) We have some pits where we have two coal shifts and a ripping shift, two eight hours' shifts, and a ripping shift, and the same thing applies when the ripping is done when the colliers are out of the pit.

(*Mr. Smillie.*) That is what we mean by "between the shifts."

18089. (*Mr. Cunynghame.*) At all events there is this to be said. I do not know if you are aware of it, but a Committee, whose Report has just been published, has recommended as one of the things to be done, if possible, blasting between the shifts as much as is reasonably practicable. I suppose that is a good plan as far as it could be done ?—I do not think that blasting at the face in Scotland has ever caused an accident.

18090. Is it not better, in view of the fact that these things may set light to gas and dust, to blast between shifts if you could manage it, so that if unfortunately something occurs at least as few men as possible are injured ?—There is no inspector in Scotland who would say that is between shifts—what you are referring to.

18091. I am not disputing the phrase. I am only asking this. I suppose you will say at once it is a good thing that all blasting should be done when as few people as possible are in a pit in any gassy or dusty mine ?—Except in a dusty mine I do not think there is any danger.

18092. Might not more be done in that direction in blasting when the fewest possible men are in the pit than is done at present ?—I do not like to admit that, for this reason, because in the 12th General Rule—certain shots are to be fired between shifts—that shot fired at Drumpeller was fired under the 12th General Rule and fired between the colliers' shift and the rippers' shift. That is what we call "between the shifts," but if you suggest "between the shifts" might be during the rippers' shift——

18093. I have dropped the term "between the shifts" altogether, and I only asked you this question: might not more be done than is done at present to blast when as few as possible of the men are in the mine ?—In Scotland I do not think there is any stone blasting of any consequence done during the hewers' shift.

Digitized by Google

Mr. D. M. Mowat.

18 April 1907

18094. When any men are in the mine. Do not use the word "shift" any more?—Hardly such a thing as that.

18095. Now about coal blasting, would it not be possible for coal blasting to be done when the men are out of the mine more than at present?—No.

18096. Why not? It appears to me the men might make a hole and get everything ready, and you might have blasting going on when they had gone away, and they would come back and remove the stuff that had been blasted. I want your view upon that?—In long-wall workings we have little or no shot-firing in the coal at all, but in stoop-and-room workings I do not think it is possible for a man to prepare himself so that his hole may be bored the last thing at night and fired after he left. A shot would not bring enough, and before the next shift was finished you would require another shot. It is like the brushing case.

18097. Still more might be done to let the preparation of the shot be the last thing a man did?—In Scotland I do not think there is any danger whatever from shot-firing except the danger of shot-firing on a haulage road. I do not think there are any statistics as to accidents which would contradict that. I am talking of Scotland.

18098. Do you use bobbinite as an explosive?—Not now. We have used it, but we have stopped it.

18099. Why?—Because we had bad reports. We had no bad experience.

18100. What do you use now?—We are using arkite and Saxonite.

18101. Carbonite?—I do not think we are using carbonite.

18102. (*Sir Lindsay Wood.*) Is it not the custom in Scotland for the hewers to sometimes fire two shots themselves during their shift?—Yes, it is, in stoop-and-room workings.

18103. That arrangement is still more difficult if no shots are fired during the coal shift?—It is impossible. We could not work.

18104. Hard coal requires a good deal of blasting done and it would be impossible?—Yes.

18105. You recommend that care should be taken in the main ways before the shots are fired?—Yes.

18106. The shots you speak of as brushing or ripping shots are practically at the face?—Within 10 ft. of the coal face.

18107. Where there is not much danger of an explosion being accelerated by the dust?—No.

18108. Those are always done during the night shift?—Yes, as a rule. There are exceptions to that. In a pit opening out where you are pushing with some speed to develop the colliery, your coal shift and brushing shift may be not so clearly separate from one another. A man may have a contract to drive a place and he takes down the coal himself and brushes himself. He takes down the coal and then brushes, and the time of doing these two operations may come together. That is exceptional when it happens.

18109. That is in a single way?—Or two levels, winning out places.

18110. There would not be coal passing over that?—No. There is no danger to my mind in that at all.

18111. The great cause of coal dust being on the wagon way is coming off the tubs during the haulage?—Yes, and being crushed.

18112. That would not occur in the case you name, which would be in a new wagon way?—There is no danger whatever in what I suggested just now.

18113. (*Mr. Wm. Abraham.*) Is there much coal worked in your district by blasting?—Yes, in stoop-and-room workings, not much in the long-wall workings—pillar-and-stall—we call it stoop-and-room.

18114. That would be a reason why you could not do away with blasting during the shift, is it not?—Yes.

18115. Who prepares the shot, who fires it in that case?—The man himself where the pits are worked with naked lights, and the shot-firer in the pits worked with safety lamps. With safety lamps all shots are fired by a shot-firer everywhere.

18116. Where safety lamps are used a man prepares the hole there?—Yes.

18117. Does he do anything with it after?—Charges it and the shot-firer fires it.

18118. He does everything, he places the explosive in or rams it?—Yes.

18119. Who carries the detonator?—He gets the detonator from the fireman. When the fireman comes round the fireman gives out the detonators. He carries them in our work in a small box holding one dozen.

18120. What is the nature of the precautions that you would recommend to guard against the danger of explosion by coal dust?—What I would say is this, that haulage roads which can be watered without serious results and increased danger on account of falls, ought to be watered or ought to be divided up into zones by watering. I do not think it is possible to remove it—that is my impression; I have not tried it—so that there would not be sufficient dust left to continue an explosion, but in a haulage road where watering would be fatal to the road and dangerous as well, I would say that nothing but safety lamps should be used in that pit, so as to do everything possible to prevent an ignition of gas, and at the same time every possible precaution that can be conceived, both under the present existing Order and the Mines Act, ought to be put into force. That is, that the shot should be fired with the best explosive, that the men should go to the pit not during ripping shifts, and I go further and say it should be fired between the hewing shift and the ripping shift.

18121. Those precautions would require some alteration of the Rules?—I do not think so. I think General Rule 12 in the Mines Act provides for it all right, almost absolutely

18122. Does General Rule 12 provide that every shot should be supervised by the manager?—No. That is a thing that is not provided for. That might be added, that a shot in such a haulage road as that ought to be authorised either by the manager or the under-manager, that a shot should not be fired at the option of anybody.

18123. Does it provide that the road should be sprinkled with salt or calcium chloride?—It does not provide as to that. I cannot speak as to that.

18124. After all there are some precautions in your mind required that would also require the strengthening of the law and of the Rules to enforce those precautions?—Yes. What I have said already upon that point is this: such a shot should not be fired unless authorised by the under-manager, and in addition to that, always keeping to the place that you cannot water, that the explosive used is a permitted explosive, and that all the men are out of the pit except those firing the shot and those absolutely necessary to attend.

18125. I think I understand you to say for all extra precautions necessary that are not made obligatory by rule, a rule should be made to make them so?—Yes, I think so.

18126. (*Mr. Ratcliffe Ellis.*) You do not consider, I gather, that the face is a dangerous part of the mine?—No, I do not think there is any danger from dust at the face.

18127. The danger is in the haulage road?—Yes.

18128. And the danger exists further away from the face than near the face?—Yes.

18129. It would be quite possible, I suppose, to have a dry and dusty haulage road and still that dust should not be seen adhering to the roof and sides. I want you just to look in answer to that question at General Rule 12, if you have it before you?—Yes.

18130. There is a distinction made between the face and the haulage road?—Yes.

18131. Sub-clause (*h*) provides that if the place where a shot is to be fired is dry and dusty then the shot shall not be fired unless one of the following conditions is observed. One is that it is to be watered if it is not in a wet state, and the second is where the watering would damage it the explosive must be used with water or other contrivance to prevent it from inflaming gas or dust, or is of such a nature that it cannot inflame gas or dust. That is to say, the one or the other, not both?—That is not in the haulage road, that is any dusty place.

18132. Whether haulage road or anywhere else?—Yes.

18133. Then you come to the next Section, "If such dry and dusty place is part of a main haulage road or is a place contiguous thereto," and going on to say "and showing dust adhering to the roof, and sides," if it did not show dust adhering to the roof and sides, although it was a haulage road, this would not apply?—I cannot conceive such a state of things.

18134. If it did not say "And showing dust adhering to the roof and sides" this would not be treated as a haulage road although it is a haulage road, but under sub-section (*h*) as a dry and dusty place?—I do not think it is possible.

Digitized by Google

If you sweep the floor of this room there will be dust on the mantelpiece.

18135. "And showing dust adhering to the roof and sides." Your view is that some dust is not dangerous at all?—Yes.

18136. You have not come to that conclusion from experiment?—No.

18137. Why do you think that?—We have had many ignitions of gas in Scotland and in various parts of pits and we have only had one or two dust explosions.

18138. Have you had ignitions in pits where there has been a dust explosion?—I cannot speak as to that; there have been so few dust explosions I cannot tell.

18139. With our present information you think that there is some dust that needs no precaution at all?—I think so.

18140. Supposing this Inquiry should disclose that all dust is more or less dangerous—it is a question of degree—then you would be prepared to consider provisions for safety in connection with all dusty mines?—It would come under the category——

18141. Of a dry and dusty mine. Assume that for a moment. Would you think it desirable that provisions should be made for preventing an accumulation of dust?—Of course I have made no experiment, but my idea is that even although everything was done to prevent accumulation—in Scotland we have closed tubs, very few of any other kind than closed tubs, and in spite of all, dust or fine coal accumulates to some extent, and even though cleared away I think some would be left.

18142. Supposing it is dangerous to have an accumulation of dust, I am speaking of a general regulation that it must be prevented, the manager might prevent it in two or three ways; he might take steps to prevent it accumulating or he might choose to remove it when it had accumulated; he might please himself whether he adopted means to prevent the accumulation, or, if he did not, whether he took steps to remove it when it had accumulated. Do you think it desirable that there should be some general provision that accumulations of dust should be prevented?—If we found out that it could be prevented. I would not like to see a rule made that we could not carry out. I am not clear that we could prevent it.

18143. Supposing there are ways by which you could prevent it you think it would be desirable that it should be prevented?—Yes.

18144. The method, of course, being left to the manager how he would do it himself?—Yes, as far as practicable.

18145. Having done that, assuming you have kept yourself as clear from dust as you can, you do not think you could keep yourself sufficiently clear so as to make non-dangerous what is left?—I do not think so.

18146. That, again, would have to be found out by these experiments?—Yes.

18147. Therefore, would you not then consider it desirable that you should do something to prevent an explosion extending, in case you happened to have an explosion, by having protected zones?—Yes, I think so, wherever it is possible.

18148. Wherever it is possible you should have zones?—Yes.

18149. With reference to the character of the protected zone, it might be watering or it might be cleaning from dust, if it could be sufficiently cleaned?—Yes.

18150. You would leave that to the manager, as to which course he would adopt?—Yes.

18151. It might be again that you could not water. Water would bring about more mischief than it would prevent?—Yes.

18152. You agree that there are many cases of that sort?—Yes.

18153. In those cases it could only be watered by having a particular zone prepared for it, archways built, and so on?—Yes.

18154. Have you any difficulty in saying that there are cases in which that could be only maintained at a very great cost?—We have cases where an arch will not stand.

18155. Will not stand at all?—No.

18156. Therefore there are cases where you could not have a prepared zone of that description?—No.

18157. With reference to the cleaning of the dust, if the manager chose to say, "I would rather clean it away than water it," it would want a prepared zone for that?—Yes.

18158. He could not clear ordinary roads sufficiently. If he could not maintain a prepared zone for watering purposes he could not for dusting purposes; the same difficulty would arise there. In cases where you can do neither one nor the other practicably, your view is that you would make very stringent regulations with reference to shot-firing?—Yes, and lamps.

18159. As to shot-firing, you have suggested one addition to the General Rules, and that is that in haulage roads the shots should only be fired under the immediate supervision of or by permission of the manager?—Yes.

18160. Do you think that the present provisions with reference to drilling the hole and stemming it are in sufficient detail to secure safety?—This comes from Drumpeller, to give an illustration of it. My impression is that the fireman who fired the shot did not know that it was stemmed with powder. That is a case pointing out the necessity for something. On a main haulage road the shot-firer should see the hole charged or charge it himself; perhaps that is the better way to put it.

18161. He should see that it is properly drilled?—Yes.

18162. Do you think it desirable that there should be some additional rule providing for that?—I think that is desirable.

18163. I suppose the blown-out shot is the thing to be avoided?—Yes.

18164. That very largely depends upon the way in which the hole is drilled and the way in which it is charged?—Yes; I do not know so much about the hole being drilled.

18165. If it is straight, for instance.

(*Mr. Wm. Abraham.*) You could not drill it very well if it was not straight.

(*Mr. Ratcliffe Ellis.*) I do not mean to say it is at an angle.

(*Witness*). I have seen a hole with a good bend in it.

18166. That would be a very dangerous hole?—No, I do not think so. I think that would hold the stemming better than a straight hole. I think the hole should be charged by the shot-firer.

18167. That is the charging of the hole?—Yes, it should be done by the shot-firer in an important shot such as this.

18168. Have you any system of giving instruction to the men as to the drilling and charging of the shot where the men charge and drill the hole?—Not in ordinary work. Rippers, for instance, bore and fire the shots from their own experience, but in a main haulage road where a shot is to be fired generally the overman would give instructions.

18169. Do you take any steps to instruct the overman?—The overman is one of the best men we have.

18170. You have no special instruction?—No.

18171. The overman is not a shot-lighter, he is a manager. Take the shot-lighter; are there any means taken to instruct them with reference to their duties as to shot-firing?—In our own case this is what we do: When the Explosives Order comes out, the official Explosives Order, we get so many copies and give every shot-firer a copy and call the shot-firers together. We give them these copies and make them sign a form of receipt. We put it that way, always repeat to the men that they have been appointed a shot-firer and have received a copy of the Rules to impress it upon them.

18172. Signing a receipt would not be much use, but you take means to see that he reads the Rules?—The man appointed is usually a fireman, a man of more than usual skill.

18173. You do take sufficient means to see that he is properly instructed in his duties?—Yes, he understands the rule.

18174. With reference to lamps, your view, I understand, generally is that in steep mines introducing lamps might be the means of keeping you from the possible danger of an explosion, which you think is very improbable?—Yes.

18175. It would expose you to serious dangers from another cause which is more certain. Rightly or wrongly that is your view?—Yes, I think there is no doubt about that in our Scotch mines.

18176. The statistics you have shown to his Lordship—— I will put them in later on. I understand I was not coming up just now on the question of lamps.

18177. You can give statistics which, in your view, prove that?—Yes. My figure, if it is any use just now,

Digitized by Google

Mr. D. M. Mowat.

18 April 1907

is this: the total haulage accidents in Scotland in two districts 0.52 and 0.53 per 1,000,000 tons fatal accidents, and in Britain it is 0.81, a very considerable amount less in Scotland. That is 0.525 average as against 0.81 total haulage accidents; accidents by falls are 1.98 as against 2.09. There again, we are under the average of Britain.

18178. Do you think taking it per 1,000,000 tons is a right way to do it?—Yes.

18179. Have you the number of persons employed. Why do you select per 1,000,000 tons?—Per 1,000,000 tons is the commercial way of looking at it.

18180. Is it the statistical way of looking at it?—If I go to a colliery where a certain number of men are employed and if by changing the system I employ less men and produce the same amount of coal——

18181. For comparative purposes you have to compare it with the same system. Yours may be a better system. That is not the system from which the statistics are prepared?—They are prepared both ways. They are given in Mr. Delevingne's evidence. I think they are given in three ways. They are given per 1,000 persons employed and per 1,000,000 tons.

18182. You think that is the better plan?—Yes.

18183. You are comparing yours with the per 1,000,000 tons rate in the statistics?—I have taken all my figures from Mr. Delevingne's evidence.

18184. You think it compares favourably with that class of accidents?—Yes.

18185. You are speaking of accidents on haulage roads and falls of roofs?—Yes, these are all the accidents given.

18186. How does it compare with reference to explosions?—For explosions the average in Mr. Delevingne's figure was 0.205 for Scotland, and the average for Britain 0.33. We have only 60 per cent. of the average for Britain in one case and practically the same in another case. The total accidents include under the head of accidents, falls of roof on face, falls on roads while passing or working, falls of ground in shafts—all haulage accidents. Our total is something like 2.71—I am taking the two districts all together, you understand—as against 3.23, the average for Britain.

18187. That confirms your view?—Yes, and our own statistics which I will give again about our colliery. I have them here but they are not in a form to put in.

18188. Could you say what the non-fatal accidents in Scotland are?—No, I have not them.

18189. For the five years the non-fatal accidents in Scotland from explosions seem to be 315?—I do not doubt that.

18190. And 462 injured, non-fatal?—I do not doubt that, but a great many of these would not be off a week. The reason these look bad is the system of reporting explosions is different from other accidents.

18191. (*Chairman.*) It is the same in all the country round?—If these were reported on the same basis as haulage accidents and falls they would be exceedingly small; out of 300 there would not be more than 10.

18192. (*Mr. Ratcliffe Ellis.*) Compared with other districts they are very much fewer?—In safety lamp districts they are always fewer.

18193. You have a greater number of ignitions, of course?—Yes.

18194. They are insignificant?—Yes, they produce no serious danger. I have seen Mr. Ronaldson's evidence. Often he has called about an accident and found that the man is working.

18195. (*Mr. Wm. Abraham.*) That is a proof there is gas?—Yes, and yet no danger. A bonnet-full of gas very often singes a man's hair.

18196. (*Mr. Smillie.*) Have you a number of naked-light collieries under your charge?—I have.

18197. Have you had any explosions within recent years at any of your naked-light collieries?—Do you mean somebody being burned?

18198. Ignitions of gas, as you call it?—Yes, we have had ignitions of gas.

18199. Have you any that you yourself have been personally in connection with so that you are able to speak from your personal experience of them?—Have I been in the pit at the time?

18200. Yes, and know the whole circumstances?—I know the circumstances of most of them. I have been in the pit when a man was burned, but not beside him.

18201. They are reported to you?—I have been in a pit when the man was burned, but not in the place. I have kindled gas myself. I never was burned.

18202. Do you know whether or not there are explosions in naked-light pits in Scotland in which men are slightly injured which are not reported to the inspector?—No, I do not know of any case.

18203. It is possible, I suppose?—It is a breach of the Act. I do not know of any case.

18204. In your own naked-light collieries you say that you have had some explosions. Were they only slight explosions?—No, we have had serious explosions, too. That was not a gas explosion we had—that case at Drumpeller. We have had deaths from explosions.

18205. An explosion of gas, at least an ignition of gas, that burns a person very severely, sufficiently to kill him, would you call that an ignition or an explosion?—An explosion; they are all called explosions in the Report. An ignition of gas is a small quantity of gas which merely kindles and does not so extend as to give out force. We have not had an explosion of gas in my experience in the sense that you refer to now with any force. We never had a pit during those 29 years I have had experience at Summerlee where damage was done by an explosion.

18206. Let us deal with the statistics for the last 10 years for naked-light collieries. Do you know whether or not in any of those explosions in naked-light collieries dealt with by the mines inspector there has been considerable force?—If you mention one you may bring it to my recollection; I have not one in my mind.

18207. Do you remember Skellyton, Larkhall, in which two men were killed?—I could not speak as to the circumstances. I do not know.

18208. There are a number I cannot mention just now in which the trap-doors were blown open, and screens blown out 200 yards from the scene of the explosion. You call that an explosion and not an ignition?—That is an explosion. I say in 29 years' experience I do not think we have had a case where a trap-door was blown down, or anything approaching that. We have had plenty of deaths unfortunately. A man has died by burning, but not by force or anything of that kind.

18209. Within 29 years?—Yes.

18210. At all your naked-light collieries?—At all the collieries together.

18211. Have you had any explosions reported at your collieries in 29 years in which no person was burned, but a very serious explosion took place which did open the trap-doors?—No, I cannot speak as to that unless you tell me the name.

18212. At Dykehead Colliery?—No. What I mean to suggest is that all these have been ignitions where there have been fatal accidents, but they have not been attended with force.

18213. I have attended many fatal accidents and explosions in Scotland during the past 10 years, and I have found evidence proved that in many of those cases there was a considerable quantity of gas, and that the force was felt 200 or 300 yards from the place of the explosion?—That is not my experience.

18214. At Drumpeller Colliery you had an explosion?—Yes.

18215. Is that a naked-light colliery?—It was a naked-light collery; it has stopped now.

18216. And a dusty colliery?—Yes, the haulage road was very dusty.

18217. Did the force of that explosion traverse a very considerable portion of the road?—No, there was very little force. There were signs of burning from the site of the explosion right up to the pit bottom, but little or no force.

18218. Did the signs of burning, or whatever force there was all go out the intake aircourse?—Yes, to the downcast pit.

18219. It did not go any distance at all down the return airway?—It did not go into the return airway.

18220. Was the return airway from the point the explosion originated dusty?—No.

18221. The intake was?—The haulage road was dusty.

18222. Was there any part of the road traversed by the explosion which was either free from dust or wet?—No; the explosion travelled right up to the downcast pit bottom, but did not cross at any distance. The pit bottom was wet, and it stopped there; not very wet, but damp.

Digitized by Google

18223. Was the other side of the bottom dry and dusty or wet?—It was dry a bit, but not near the bottom. It was damp a bit at the bottom.

18224. Do you think it was the open shaft or the wet shaft which stopped the force of the explosion?—Want of dust.

18225. You think it followed the dust as far as the dust went?—Yes.

18226. That is an argument in favour of a wet zone, or watering to stop an explosion?—Yes.

18227. You have no doubt of that from your experience?—No doubt whatever.

18228. There is a very considerable amount of shot-firing in coal getting in Scottish collieries in the stoop-and-room?—Yes, in the stoop-and-room.

18229. Do you know whether or not firing holes in the solid is on the increase?—In some districts it is; in old mining districts it is not.

18230. You remember the early system in Scotland, and I suppose elsewhere, was to undercut the coal, and after it was thoroughly undercut 2½ ft., or 3 or 4 ft., you bored the holes and fired the shots?—And sometimes sheared the coal.

18231. Sometimes cut it on one side and blew it off there. You say in some districts the firing of shots in the solid is on the increase?—It is difficult in the new mining districts to get men to hole and shear.

18232. Is that a source of danger for blown-out shots?—No.

18233. If that were being done?—Where there was dangerous dust it would be.

18234. Where there was either danger from gas or dust it might be more dangerous?—Yes; under the existing circumstances I do not think there is any danger. There is damage to the coal, but I do not think there is any danger.

18235. You said that in some of your pits arching or masonry could not stand?—Yes.

18236. In your own pits?—Yes.

18237. What is the depth of them?—About 130 or 140 fathoms.

18238. That is in longwall workings?—In some places stoop-and-room, and in some places longwall.

18239. Is your arching done where you had pillars of coal left on your main roads?—Yes. We built side walls and girders, and it smashed all the girders and side walls. *Mr. D. M. Mowat.* 18 April 1907

18240. Are you stooping?—No, it was the effect of the main coal working above it. Still, there is always that.

18241. Mr. Ellis asked you closely on the question of shot-firing. Who fires the shots for your rippers or brushers?—In those naked-light pits always the men themselves. I do not think there is any exception to that.

18242. The brusher himself?—Yes, sometimes the contractor goes round and charges them and fires them. That is a matter of arrangement between themselves.

18243. In your close-light pits?—Shot-firers appointed by the Company.

18244. Who employs your rippers?—Some of them are on shift employed by the Company, but generally employed by a contractor.

18245. Where your brushing is contracted, a brushing contractor may employ 5, 10, 15, or 20 men to work to the brushing?—Yes.

18246. Your management does not have any say in the matter as to who is employed?—No.

18247. They may or may not be skilled workmen for the work for which they are employed. The contractor takes that risk?—Yes, that is so.

18248. They may not always prepare the holes in the way suggested by Mr. Ellis, in the best way?—As I explained, I do not think that where they are working there is any danger whatever from a well-prepared or a badly-prepared shot-hole, from dust or gas I mean to say.

18249. In the ripping?—Yes.

18250. Because it is at the face?—Yes, because it is at the face.

18251. Then back the roads?—In the ordinary practice it is almost entirely done by men paid by the Company. That is not often contract work.

18252. Do you think it is carrying out the spirit of the law to give over to someone else the right to employ the workmen to do your work?—Yes.

18253. You think it is within the law?—Yes.

18254-5. (*Chairman.*) Do you wish to say anything more?—I do not think so.

TWENTY-EIGHTH DAY.

Wednesday, 1st May, 1907.

[PRESENT:

Lord MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
H. H. S. CUNYNGHAME, Esq., C.B.
WM. ABRAHAM, Esq., M.P. (Rhondda).
F. L. DAVIS, Esq.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. CHARLES EDWARD RHODES, called and examined.

STATEMENT OF WITNESS.

18255A. I am a Mining Engineer residing at Rotherham, and have been in practice for the past 30 years. I am a Consulting Engineer for collieries in Yorkshire and Derbyshire, raising nine million tons per annum, amongst others being John Brown and Company's collieries at Aldwarke Main, Car House, and Rotherham Main, the Dalton Main Collieries, Wath Main, Carlton Main, Monk Bretton, Strafford, Kiveton Park, &c. The collieries where I am adviser comprise pits working all the principal seams that are worked in North Derbyshire, South Yorkshire and West Yorkshire. I am thoroughly acquainted with the various seams worked in those districts, and with the method of getting and working the same. *Mr. C. E. Rhodes.* 1 May, 1907.

(1) My attention was directed many years ago to the cause of colliery explosions, and I conducted a large number of experiments over a considerable period of time in order to discover the best and safest type of safety lamp, and to ascertain the extent to which coal dust could either cause an explosion or increase the effect of an explosion of gas. Those experiments were placed at the disposal of the Royal Commission which was then sitting, and Sir Frederick Abel and Mr. Warington Smyth witnessed some of them. I was able to come to a clear conclusion as to the reason why many lamps then in use were un-

Digitized by Google

Mr. C. E. Rhodes.

1 May, 1907.

reliable, and satisfied myself that coal dust was a danger that must be taken into account and guarded against. I was never, however, under any conditions able to obtain an explosion from coal dust alone, but could obtain a dust explosion with a blown-out shot whenever there was present an almost infinitesimal percentage of gas. In other words, the presence of gas in such small quantity as to be harmless if alone, whenever it existed in combination with dust created a state of things when an explosion became a practical certainty given a blown-out shot to produce the conditions to start it.

(2) I will now describe the seams worked in South Yorkshire, and explain why the danger from dust cannot be dealt with by any system that can be applied to all pits alike. The seam that I have principally to deal with is the Barnsley Bed of South Yorkshire, producing the well-known steam coal of the district. This seam is the same geologically as the Top Hard of North Derbyshire. The Barnsley seam is the most important of the South Yorkshire seams and produces the greater part of the tonnage of the district. It is mainly worked now by long-wall work. Up to some years ago it was worked to a considerable extent by what is known as the bank-and-pillar system. This system consisted in taking out narrow banks, leaving pillars of considerable size between the banks. After the banks had proceeded a certain distance these pillars were then extracted. This method of work necessitated the use of shot-firing to a very great extent in all the narrow banks, but owing to the difficulties incidental to carrying on this method of work at the greater depths at which modern collieries are being worked the system has been gradually abandoned for the long-wall method. At none of the Barnsley Bed collieries that I have personally under my supervision is any shot-firing practised for getting down the coal itself, and in very few instances is shot-firing resorted to at all. The roof as a whole being of a fairly soft character throughout the district enables the ripping for making the main roads to be done without having resource to shot-firing. In one or two instances, however, the roof is a strong sandstone rock, and there it is absolutely necessary to fire shots in order to make the main roads. In North Derbyshire shot-firing is practised in the coal itself. The seams there, however, are of a less fiery character, although they are worked with safety lamps, little gas being given off, and, as a rule, they are free from dust. The other seams in South Yorkshire that are principally worked in addition to the Barnsley Bed, are the Silkstone and the Parkgate Seams, though there are others worked locally to a small extent.

(3) I am not aware of any instance where shot-firing is practised in the Silkstone Seam in South Yorkshire, either in the coal or in the ripping. This seam is of an extremely fiery character, and at the collieries that I have to deal with sudden outbursts of gas are common. In such seams as this, which are very dusty, in addition to being fiery, I have the strongest objection to shot-firing at all. In this seam in many cases the character of the roof and floor is such that moisture has a serious effect on them, and roadways in many cases could not be maintained if wet.

(4) The Parkgate Seam as a rule is not a very fiery seam, especially in the neighbourhood of Barnsley, where it is worked extensively at one or two collieries and where shot-firing is resorted to in the coal itself. It is absolutely impossible in order to work this seam in that particular vicinity to abandon shot-firing except at a very considerably increased cost of working. In addition to this, almost universally where shot-firing is practised in this seam, a considerable amount of water is made in the roof, and almost invariably the roads are damp. In the southern part of the district the Parkgate Seam is of a different character to that round Barnsley, giving off more gas, and as a rule being very much more dusty.

(5) Some 30 years ago I opened out a very large colliery near Rotherham in this seam, but shot-firing has never been practised in that colliery. Owing to very favourable conditions of roof and floor and to the character of the coal the colliery has been worked by taking narrow headings forward following up with ribbing off the large pillars left between such narrow banks, making a system of "long-wall retreating." This, as I have stated, has enabled the seam to be worked without explosives. At another colliery belonging to the same firm, but at a very much increased depth I have opened out the Parkgate Seam by a similar method, but after working the pit for some years it was found impossible to continue the system owing to the lifting character of the floor closing up the roads and making it impracticable to maintain them for a sufficient period to allow the pillars to be extracted. I was therefore reluctantly driven to work out the colliery on the long-wall method. This reluctance was due to the fact that it was impossible to adopt the long-wall method without firing shots in the ripping. Although the seam lies at a great depth, approximately 600 yards and over, the rock above the coal retains a considerable amount of moisture, and water breaks in at times into the working places, and as a general rule they are damp. In course of time, however, the main roads undoubtedly get dusty, but after the roads are once made they require no more doing at them, and it is unnecessary to fire shots in them again, except to a very limited extent, the roof in this case however being rock it is not affected in any way by watering, so that the application of such means to damp the dust would not be at all prejudicial to the maintenance of the roadways. Where, however, the roof consists of bind watering would be impracticable.

(6) Shot-firing in South Yorkshire as a general rule is practised between shifts where the single shift system in force at most South Yorkshire pits is in vogue, but even in that case there are always a number of workmen employed on what is called the back shift. The back shift is not a full working shift though a certain quantity of coal is filled in it to enable the pit to commence coal-drawing when the ordinary working shift begins. There are a number of men down the pit during this back shift, as all the repairing work is done in it.

(7) Where isolated shots have to be fired there would be no difficulty in arranging to fire them between shifts, but where a number of ripping shots have to be fired and which form part of the daily routine of the colliery it would be impossible to arrange to fire these shots when all the men were out of the pit; the general custom being that these shots are fired at the beginning of the back shift, or what may properly be termed the "repairing" shift, these shots having been got ready during the latter part of the "working" shift. These shots are then fired when the "repairing" has got to work, and in many instances while the "working" shift is travelling. These shots having been fired, the "repairing" shift then proceed to build the packs and form the roads, making them good during the remainder of their shift. It will be seen at once where there is a strong rock roof, which it is impossible to deal with except by the aid of explosives and where the faces are advancing uniformly, that a considerable number of shots must inevitably be fired day by day in the immediate vicinity of the working faces, although in most cases when once the road is formed it is not necessary to fire shots in them. In the collieries in West Yorkshire that I have to deal with, explosives are used occasionally for "breaking-in shots," and in the faces that are worked by machines it is found necessary to fire shots at times in order to get the coal down.

(8) I have already referred to the experiments I have conducted. I found in those experiments that the whole of the high explosives depended for their safety on efficient stemming and tamping, for with all the explosives that I then experimented with, including Roburite, Securite, and others, I invariably obtained explosions with an explosive mixture of coal gas and air, and coal gas, air and dust, when I had a blown-out shot. I also conducted a number of experiments to obtain explosions with a mixture of air, firedamp and coal dust to assist Dr. Haldane in the experiments he was then making as to the after effects of coal dust explosions.

(9) From the result of my experiments in connection with safety lamps I came to the conclusion that the improvement which had been brought about in connection with lamps rendered it all the more important to remove other sources of danger if it was practicable to do so in connection with the method of getting coal. I, therefore, took steps in every direction to discontinue the use, so far as possible, of explosives, but notwithstanding all my efforts in this direction, I found it impossible to dispense in all cases with their use especially in the ripping and the maintenance of the main roads and even in the getting of the coal itself in some instances.

(10) Dust is undoubtedly a danger in connection with shot-firing. Although in my experiments I never obtained an explosion from dust alone, I did, as already stated, obtain most violent explosions from dust with an infinitesimal percentage of gas, which in practice often comes to very much the same thing, for in a well-ventilated pit, where the gas given off is diluted and carried

Digitized by Google

away in the air, you can easily have an atmosphere absolutely safe in itself, but containing a trace of gas sufficient to create the necessary conditions for a dust explosion to become possible if there is a blown-out shot. I am therefore of opinion that where dust prevails stringent precautions should be adopted in the event of shot-firing being necessary. It is impossible, in my judgment, to lay down any universal system which is applicable to all mines. In many of the deep Barnsley Bed pits it would be impossible to make compulsory watering universal; the floor would lift and the roads could not be kept open; this difficulty will increase with the development of the coalfield. My suggestion is that each colliery must be dealt with on its own merits. In a dry and dusty pit, where shot-firing is absolutely necessary, and where watering can be adopted, then there should be watering within the zone where any shot has to be fired on main roads. Shot-firing in the immediate vicinity of the working faces is a difficult problem to deal with, and the only suggestion I can make as to that is that the dust should be invariably cleared up as far as practicable, and that the whole of the small coal should be sent out of the pits where that can be done.

(11) I am in favour of the adoption of methods for collecting the dust, and in those mines where it is practicable without injury to the roof, floor and sides of the main roads, I am in favour of the air being kept damp. Where shot-firing is absolutely necessary in the main haulage roads, damping should be resorted to if possible where any dust is present.

(12) I am also of opinion that by regular and constant attention to the roads dust can be cleaned up to such an extent, if it is done constantly and the operation forms part of the ordinary routine of the management, as to render it practically innocuous, and that this would conduce to greater safety than relying on damp zones. Complete watering of the roadways is in many instances impossible for reasons already given, and therefore universal watering cannot be adopted as a means of guarding against dust explosions.

18256. Are you a mining engineer residing at Rotherham, and have you been in practice for the past 30 years?—Yes.

18257. Are you a consulting engineer for collieries in Yorkshire and Derbyshire?—Yes.

18258. You have mentioned in your Statement various collieries, and the collieries where you advise comprise pits working all the principal seams that are worked in North Derbyshire, South Yorkshire and West Yorkshire?—Yes.

18259. Are you thoroughly acquainted with the various seams worked in those districts, and with the method of getting and working them?—Yes.

18260. Have you been anywhere else?—I served my time in Lancashire, but I have not had an intimate acquaintance with Lancashire except by occasional visits since that time. I have reported on collieries in South Wales, but I cannot say I have an intimate knowledge with the collieries in South Wales.

18261. You have some idea of the main differences between, say, the South Wales collieries and the collieries in the North?—I have.

18262. Have you made a large number of experiments in order to discover the best and safest type of safety lamp, and to ascertain the extent to which coal dust could either cause an explosion or increase the effect of an explosion of gas?—I have.

18263. Were those experiments placed at the disposal of the Royal Commission then sitting?—They were.

18264. Did you find that many lamps were unreliable, and did you satisfy yourself that coal dust was a danger that must be taken into account and guarded against?—I did.

18265. I think it seems to be generally acknowledged that a coal dust explosion may take place in the absence of all gas. You rather doubt that, I gather. You say there must be what you call an infinitesimal quantity of gas to start the explosion?—That is the result of my own observation and experience.

18266. In the case of a blown-out shot, for instance, where apparently there is no gas in the mine, might it be that the ignition of the explosive itself would cause an amount of gas that would play a part in the explosion?—I think it may be sufficient to cause the elongation or the ignition of the dust to spread rather forward from the point of ignition than would otherwise be the case; but I do not think it would be sufficient to make the whole body of coal dust absolutely of an explosive character.

18267. Would you suggest that the infinitesimal quantity of gas that is mixed up in coal dust by a blown-out shot might be sufficient to initiate an explosion, whereas if there was no gas there would be no explosion?—That is my opinion. But further than that I think that in all collieries there is always present that infinitesimal quantity of gas.

18268. What do you call an infinitesimal quantity?—A quantity that you can only get at by analysis—a quantity that you could not trace by detection on a lamp.

18269. Not even by the most sensitive lamp?—No.

18270. Therefore you are of opinion that experts would say it is not beyond controversy that an explosion may be initiated absolutely in the absence of gas. You say, on the contrary, that an explosion cannot be initiated absolutely in the absence of gas, but a very small quantity of gas that cannot be detected by a safety lamp would cause it?—Yes.

18271. It comes to very much the same thing in the end?—Yes, very much the same thing.

18272. There is no test by which you can find out whether this infinitesimal quantity of gas is present or not?—That is so.

18273. You have principally to deal with the Barnsley seam, and you describe how you work this seam, and in some places it is necessary to fire shots?—Yes. My object in describing the alteration in the method was to bring before you the way in which the use of explosives for getting down the coal has gradually been abandoned in South Yorkshire. The old-fashioned method of working the coal by what is known as the bank-and-pillar system, which was at one time generally adopted, made it impossible to do without powder or some other explosive in the narrow banks; but when the long-wall method was introduced it enabled explosives for getting down the coal to be to a great extent dispensed with.

18274. Except where the roof was of strong sandstone rock?—When it comes to a question of ripping the roof down, as distinct from using explosives to get the coal down, shot firing is in many collieries unnecessary, except for the purpose of ripping where there is a rock roof and where it is impossible to do without shots.

18275. You consider it very desirable where it can possibly be done that shot-firing should be dispensed with?—I do. That is the practice I have adopted myself.

18276. And where you are obliged to have shot-firing, you practice it between shifts?—So far as possible.

18277. You say "so far as possible." Would it not be possible always to see that there are only a very small number of men in the pit when you fire a shot?—In the case of one colliery I have to deal with, where we have a very strong rock roof, and where a large number of the ripping shots have to be fired, then those as a rule are fired just when the shifts are changing. At that time there is a large number of men in the pit, because the one shift is leaving work, and the second, or repairing shift, is coming on. The shots are fired just between the end of one shift and the commencement of the other, so that the repairers can then deal with the debris blown down by the shots, build the packs and prepare the places for the next shift coming on.

18278. Would it not be possible to have an interval between the working shift and the repairing shift when the shot-firing should take place? Might not the working shift go on to the top and the repairing shift come down, say, half an hour later?—It would be difficult to adopt in practice.

18279. How often do you conduct shot-firing?—Every afternoon.

18280. You say it would be impracticable to have any interval between the two shifts for that purpose?—It would. Most collieries work two shifts of coal getters, and in some there is a third; the third in any case is a repairing shift.

18281. Do you consider it would be impracticable to make a General Rule that not more than 10 men should be present in the pit when shot-firing is going on?—It might be practicable in some cases, but it would not be practicable as a general rule.

18282. Would it be practicable in your collieries?—When we have only one or two shots to be fired. Arrangements are made from time to time, when shot-firing

Digitized by Google

Mr. C. E. Rhodes.

1 May, 1907.

is indispensable, that is where it is not adopted usually, then special arrangements are made.

18283. Do you fire more than one shot at a time?—I should never fire more than one shot at a time in any working place myself or allow it to be done.

18284. You consider that to be dangerous?—I do. I do not see the object of it underground.

18285. The object, I suppose, is to save time?—Where you are putting a ripping shot in there would be great danger in firing two shots together, one probably acting and the other failing to act, because it would render the possibility of the men entering into that working place unsafe for the rest of the shift, whereas if there was only one shot fired they would know whether it had done its work or not.

18286. There might be a miss-fire?—There might be a miss-fire.

18287. Supposing there was a miss-fire, how long an interval would you suggest there should be before the men could safely approach the shot to see what had happened?—Half an hour, where you use detonators. I think that would be enough. I have known a shot hanging for ten minutes with a detonator—that is the outside of my experience.

18288. What would that hanging fire for ten minutes arise from?—I made some experiments at the time with an ordinary detonator, and came to the conclusion that the ignition had not been perfect and the touch-paper between the fulminating and the explosion had gradually burnt, and it had caused the detonator to hang fire for five or six minutes, and then it had gone off. It was some seven minutes after the time of the electric battery being turned on.

18289. What sort of percentage of detonators are defective?—There is not a large percentage now.

18290. What would you call the percentage now? Have you made any inquiries about it?—I have not; I could not say.

18291. Should you say 5 per cent.?—I should not think there are 5 per cent. defective.

18292-3. Five per cent. would be rather a serious matter, would it not? Can you suggest any means of testing detonators?—You can test one type of detonator before using it to see whether the current is perfect, but you cannot test any detonator to know whether the detonator itself is in absolute working order or not. We always take a percentage out of each consignment and test them—say three or four out of every hundred—and if we happen to come across one which is defective, we then draw attention to the fact, but as a rule we find now that detonators are very reliable.

18294. Your experience is that if you allow half an hour that is ample, even where the detonator was badly made and miss-fired?—Yes.

18295. You have made experiments which show, in your opinion, that the whole of the high explosives depend for their safety upon efficient stemming and tamping?—That is the result of my experience.

18296. Do you consider there is much difference between the various kinds of high explosives with regard to safety?—I do not think generally that there is very much difference.

18297. What regulations would you suggest with regard to shot-firing? I suppose you would have the watering regulations carried out?—In all cases where any dust is present I should certainly insist upon the watering regulations being strictly carried out wherever a shot is fired in any main road of any description.

18298. In any mine?—In any mine.

18299. Where there was any considerable amount of dust?—Yes, where there was any considerable amount of dust.

18299A. Some people consider that a very small amount of dust would be sufficient either to carry on or raise an explosion. I do not know whether you have made any experiments with the view to finding out the amount of dust which would be dangerous?—I have not.

18300. Who would be the person to say whether a mine was sufficiently dusty to make it necessary to water before firing a shot?—My personal opinion is that in any mine where shot-firing is regularly practised the place where a shot is going to be fired should be reported by the deputy of the previous shift, and that the whole of the shots should be checked off by a competent man before they are allowed to be fired.

18301. Checked off, you say?—Yes.

18302. How about the watering?—He would have thorough knowledge of the pit, and he would know exactly the conditions under which the shot was going to be fired; and the charge deputy of each district, or each part of the pit, should be the responsible person. He should report, and if there were any special precautions to be taken the onus should be thrown upon the manager.

18303. Does that apply everywhere—to the face as well?—Yes.

18304. Wherever the shots are fired you would have all these precautions taken?—I should. I should have them all reported exactly in the same way as the condition of every place in the mine is reported, prior to the commencement of the shift.

18305. You would not allow shot-firing in the haulage road without the under-manager or manager deciding as to each shot?—That is so.

18306. With regard to the 20 yards radius—do you consider 20 yards is enough?—I do not think it is enough. If a large amount of dust is prevalent in the main road, I think the precaution should go beyond that in what you might term a fiery and dusty mine. Where dust is prevalent in any considerable quantity in the main road the damping should be beyond the 20 yards radius.

18307. What radius do you suggest?—I should think at least 50 or 60 yards on each side, so as to prevent the dust by any possibility getting back to the zone where the shot was being fired.

18308. I observe you say "getting back"?—Yes. As soon as ever a shot is fired a vacuum is created, and then it draws in. I have myself seen shots fired where the ground was perfectly damp all round, and as soon as ever the shot had gone off the dust has been brought back to the point where the shot had been fired from.

18309. You think it might be drawn in almost as far as 50 yards?—Yes.

18310. So that in that respect you think the rule with regard to watering might be amended, and it ought to be compulsory in dry and dusty mines to water to 50 yards?—Yes.

18311. Would you have the roof and sides watered as well as the floor?—I think so—damped. It is not necessary to make it wet—just to damp it is quite sufficient so as to render the dust damp.

18312. And you think that could be done in the mines where you have had experience without any danger of falls of the roofs and sides?—In the main road, because I do not think shot-firing is always necessary. It is only an occasional shot that would have to be fired after the road is once made.

18313. And you think a little damping would probably cause no great danger?—A little occasional damping would not.

18314. You consider that the improvements in connection with safety lamps render it all the more important to remove other sources of danger, if it is practicable to do so, and you say you take steps to discontinue the use, so far as possible, of explosives, but you cannot in all cases dispense with them?—That is so.

18315. With regard to making compulsory watering universal, you say in many of the deep Barnsley Bed pits it would be impossible to make compulsory watering universal; the floor would lift and the roads could not be kept open, and your suggestion is that each colliery must be dealt with on its own merits?—Yes.

18316. Apparently you are of opinion that where complete watering of floor and roof and sides can be carried into effect throughout the mine, if it can be reasonably done without increasing the danger of falls in the roof and sides, it ought to be done?—I am.

18317. In all dusty mines?—In all dusty mines where the character of the roof and sides permit of it.

18318. You think that would be more efficacious than any system of cleaning?—Undoubtedly. There is no doubt a very great deal could be done by a system of regular cleaning up of the whole of the main roads in the pit; and if the cleaning up of the dust was resorted to as a part and parcel of the daily routine the presence of dust could be reduced so as to render it a very inconsiderable source of danger.

18319. You mean where there is no water?—Yes, except in the case of water it becomes muddy and dirty, and makes it unpleasant for the men to travel, and the dirt clogs the wheels of the tubs, and so on.

Digitized by Google

18320. Not from the point of view of danger, but from the point of view of the agreeable working of the mine it would be desirable in all cases that the dust should be collected and taken away either in a wet or dry state ?—Yes.

18321. If the mine is dry it should be taken away if you could not wet it, and if it could be wetted it should be wetted ?—Yes.

18322. Have you gone into the question of how dust can be collected from the mine without watering and taken away and disposed of ?—I have seen several methods that are now under consideration. One is very much on the same lines as the carpet dust extractor.

18323. The vacuum cleaner ?—The vacuum cleaner—and experiments are now being made at one or two collieries I have to do with, with the object of seeing to what extent it can be applied in collecting the dust, not so much in the main road but in the goafs in the immediate vicinity of the working places which it is now impossible to get at, and which, in my opinion, makes the dust probably more difficult in that direction than any other.

18324. To a certain distance inside the goaf you would try to collect the dust that congregates near the outside part ?—Yes.

18325. Do you know anything about the experiments with vacuum cleaners, and how far they have been successful? —I have only witnessed one and I am now proceeding with further experiments, therefore I am not able to express a definite opinion. The almost universal abandonment of the riddles in our deep pits in South Yorkshire has been another advantage in ensuring the whole of the small coal being sent out of the pit. Up to a very few years ago the riddles were almost universally used, but now, with the exception of about two collieries in South Yorkshire, they have been abandoned. I have taken them out of three large collieries this last fortnight.

18326. You do not say anything about the dust shaken out of the tubs ?—I do not. There is no doubt that there is a considerable percentage of dust shaken out of the tubs; and at most collieries they adopt methods to prevent it trickling out on to the main roads, to a very great extent on account of the inconvenience that the dirt running on to the main roads causes.

18327. What is your experience of the tubs in your district—are they fairly dust-tight ?—Generally they are.

18328. I suppose they are not covered ?—They are not covered.

18329. You do not suggest they should be covered ?—No; I do not think it would be practicable to cover them.

18330. Do you water the tubs in your mines ?—No.

18331. Do you think that could be done ?—It could be done, but I do not think there would be any particular object in doing it.

18332. You do not think that would be practicable ?—If the tubs were watered and the coal damped when it came out, and it had to go down the mechanical screens, very small coal, as fine as three-sixteenths, or less than that, it would clog the screens up and be a great source of difficulty in screening and manipulating the coal on the surface.

18333. You do not think damping the coal would have any great effect in preventing the coal getting out of the tubs ?—I do not think it would. You only damp on the top, and as a rule the large lumps of coal are on the top and the small at the bottom, and any small that came out would be the first lot of small that had been thrown into the bottom by means of the shovels.

18334. Do you think the tubs are now in a sufficiently good state of repair in your mine ?—As a rule, yes; for the reason I have given, that it is a very great disadvantage to have coal trickling on to the road. It might throw the tubs off the rails. As a rule, precautions are taken to prevent the coal running out. In some cases where the mines are very low and where the tubs get broken by the colliers putting the timber into the tubs—by breaking a board out of the end very often—it is difficult to prevent the coal trickling out on to the main roads.

18335. I suppose every now and then the colliers do that ?—They do. Where a mine is very low if there is not room to lay them on the top they knock a board out at the bottom so that they can put it through the broken board.

18336. Can they not put the broken board in again ?—They could—they do not.

18337. With regard to watering the floor, we have been told by some Witnesses that where it is impossible on account of the nature of the strata to water the roof and sides, that watering the floor is efficacious against the accumulation of dust because the dust has a tendency to be blown out off the roof and sides and fall on to the floor, and if the floor is wet there the dust remains, and if the floor is dry the dust gets picked up again and becomes a nuisance and is dangerous ?—As a rule the floor in most of the South Yorkshire collieries is composed of what is called spaven, which is really an argillaceous shale, and that as a rule is affected very considerably by water, and water would and does cause the floor to lift.

18338. There would be quite as much difficulty in watering the floor, in your opinion, as the roof and sides ?—Yes, as one Witness said, in some cases there would not be much difficulty and in some cases there would be difficulty.

18339. Supposing you damped the mine and just watered by means of a fine spray—and constantly renewed the damping—would that have the same effect as complete watering ?—I am doing that now at one colliery where watering is not practicable, and up to now I have not observed any ill effects.

18340. It is a fine spray which you use ?—It is a fine spray carried in specially constructed tubs, and the wheels as they turn round work a sort of force pump, and it is very much like the spray you spray rose trees with.

18341. You are pleased with it ?—Yes.

18342. And you think that could be carried into effect where watering could not be more effectively done ?—I think it would be practicable in a great many cases.

18343. You hope to introduce this spray into parts of your mine where it would be impossible to have complete watering ?—I intend to do so if I find the result of the present experiment satisfactory.

18344. Have you gone into the question of zone watering? —That is to prevent an explosion travelling from one part of the mine to the other.

18345. That would be to minimise the explosion ?—Yes, to minimise the effects. I think the zones to be of service would have to be very much longer than has been mentioned by some of the gentlemen who have appeared before you.

18346. How long would you suggest they ought to be ? —I think they ought to be a hundred yards or more to be of service and that could be done by an absolutely careful system of cleaning up all the dust in all the main roads. I quite agree that the result of the explosions I have personally had an opportunity of seeing as a rule is mainly traceable on the main haulage roads; and where a damp road has existed it apparently has stopped the explosion travelling at the point where the explosion has come in. But I think that has been due to that dampness extending over a very considerable area, because I have seen traces of damage going to a considerable extent down a damp road—that is to say, not of fire, but traces showing that the explosion had exercised force several hundred yards.

18347. Along a wet road ?—Yes.

18348. The force of the explosion had not spent itself completely after going through several hundred yards of a wet road, as it were ?—That is so.

18349. You are sure of that ?—I am sure of that. I have seen the tubs piled on the top of one another for a distance of 200 yards down the road.

18349A. (*Mr. Cunynghame.*) Your opinion is, I think, that each colliery requires special treatment of its own ?—That is my opinion.

18350. I am not asking you for details of legislation, but I suppose your general view would be to say those that could be watered should be required to be watered. You would put it in that way, first ?—Yes.

18351. And those which could not be watered, or where it would be unreasonable to ask that they should be watered, you say they should clean up their dust ?—Yes.

18352. A sort of alternative ?—Yes.

18353. First watering, then probably clearing their dust, and some other equivalent things ?—Yes.

18354. That is your opinion of the way in which legislation should be brought about ?—Yes.

18355. I do not know whether you are able to give any opinion as to the cost of watering ?—I think it would not be felt in opening out an entirely new colliery.

18356. Or even a new seam ?—Or even a new seam in an old colliery. Where you had to begin *de novo* it would not be felt. In some mines where the ramifications of the

Digitized by Google

Mr. C. E. Rhodes.

1 May, 1907

road extend to a great distance—and in one or two cases I know there are quite 20 miles of roads to maintain—it would be utterly prohibitive in the way of expense to put pipes down such roads; and in the case of mines cut up by a series of faults, and where there is no haulage road extending from one end to the other, there would be a difficulty in even carrying the water for the purpose of spraying the roads in specially constructed tubs.

18357. You have no figures to give us about the cost of watering?—No. In a large number of collieries I have advised it, and, as I say, I have been doing it for years and we have not felt the expense.

18358. (*Sir Lindsay Wood.*) You said you did the blasting between the shifts?—That is so.

18359. Between the first and second shift going in?—That is so, in the case of collieries under my own supervision.

18360. What are the times they go in?—The shot-firing is always done between half-past one and half-past three.

18361. That is not your repairing shift?—No, the repairing shift comes on at half-past one and gets to work by say two to half-past.

18362. You do not do your shot-firing during the repairing shift?—The second shift comes on at 1.30 o'clock, and the shot-firing is done then—I am speaking of a one-shift pit now. The shots are fired between half-past one and half-past three. The rippers having had the stone blown down begin to build the packs and get the places ready for the night shift which comes on at half-past ten.

18363. There is a space of time between the shifts?—Yes. At other collieries the shot-firing is done at 10 o'clock at night. In collieries where they work three shifts there is practically no space of time between.

18364. Would you advise watering if blasting is done in the coal?—That is the difficult problem of dealing with watering—watering in the working faces.

18365. Do you think that is necessary?—I should not like to express a definite opinion as to that except on the merits of each individual colliery. There are very few collieries blasting coal in South Yorkshire at all. The only collieries where they do it are collieries which are naturally damp—the Parkgate and Shafton seam, and one or two others where, as a rule, they have a damp roof and a certain percentage of water. Take the Silkstone seam which I have mentioned in my statement. From my experience of that seam I would not fire shots in it at all; it is invariably very fiery and very dusty, and it would not be practicable to water in the face or to water in the main roads at all in that seam because the character of the strata is so extremely friable—it is practically a fireclay and works like a fireclay if water is applied to it. I have even gone so far as to take out the whole of the electric signalling on account of the outbursts we have had. That is due to the extraordinary liability of outbursts of gas. We have had outbursts which have fouled the whole of the return ways in the pit bottom for nearly a week.

18366. In the working places, as a rule, there is no gas? Where shots are fired there is none. There are one or two collieries in North Derbyshire where the seam is extremely non-fiery; practically you never hear of such a thing as gas reported at all, and it is remarkably free from dust. That applies generally to North Derbyshire in the top hard seam.

18367. You refer more to the main roads than to the actual coal getting face?—That is so.

18368. You said you had seen the force of an explosion extending for 200 yards?—Yes.

18369. Do I understand by that it is the force of the explosion, the compression of the air in the ways, and not the actual fire?—It was the force of the explosion and not the fire itself which spread.

18370. The fire did not extend through the wet zone?—No, there was nothing to be seen so far as regards any fire, but the force of the explosion had spread.

18371. That is the concussion of the air?—Yes.

18372. That except for the force would not be dangerous?—That is so.

18373. Therefore really a shorter zone than 200 yards might stop the continuation of the fire?—It might.

18374. But not the force?—But not the force.

18375. You said there was dust collected in the goafs. Is it of a fiery character?—In fiery mines I assume the dust would be fiery in character just in the same way as the dust I experimented with was fiery in character.

18376. Is it not mixed a good deal with the shale dust made by the ripping, and so on?—Where a coal will stand well holing underneath, whenever it drops there is a certain amount of fine dust produced and settles on to the goaf, and at the side pieces of timber, and it will remain there. Whenever you have a fall of roof in the goaf then invariably there is a large amount of dust appears and travels for a time across the working faces.

18377. That entirely depends upon the dryness of the air and the friability of the coal?—Entirely.

18378. A spray of water you think would be sufficient to prevent dust. Does a spray go all over the drift?—All round.

18379. Top and bottom and sides?—Yes. There is an indiarubber attachment to the tub with a sprayer very much like you spray rose trees with—a very fine spray—and the air carries this spray back and damps the atmosphere. I went down a colliery last Friday where we had tried this and was very much pleased with the appearance of the roads.

18380. (*Mr. Ratcliffe Ellis.*) I understand your view is, in fact, there cannot be such a thing as a pure coal dust explosion?—That is my opinion.

18381. That although the gas might not be found by a lamp it could be by analysis?—Yes.

18382. It has been suggested to the Commission that if there is a pure coal dust explosion, the more dust there is there the better, because the excessive quantity of the dust would absorb the oxygen and not leave sufficient to render the remaining dust injurious. Do you agree with that?—I do not.

18383. The mixture between coal dust and other kinds of dust is mechanical, not chemical, I understand?—That is so.

18384. Do you think it would be possible for a blast in connection with an explosion to separate these two dusts, so that the organic dust which is dangerous, would be swept along, and the inorganic dust which is not dangerous would be left there?—I do not quite follow the question. If there is dust, whether it is inflammable dust or non-inflammable dust, mixed together and lying on the main road, in the event of a blast it would be all blown together; and if the non-inflammable dust was very excessive, it would reduce the risk of danger *pro rata*.

18385. Do you think one result of a blast would be that it might divide the dust and take the inflammable and dangerous dust away, leaving the non-dangerous dust there?—I do not see how it could.

18386. You think that would not be possible?—I do.

18387. (*Dr. Haldane.*) It would depend upon the fineness of the dust?—Of course it is possible to conceive such a state of things as a non-inflammable dust being very granular and very much heavier in composition than a highly inflammable dust, and a blast sufficient to move the one would not be sufficient to move the other.

18388. For instance, if you had sand in one case?—If you had sand in one case and fine powder in the other, a puff of wind would blow the powder forward and the sand would drop.

18389. (*Mr. Ratcliffe Ellis.*) Take a dust which you could not explode. Have you afterwards had such a dust chemically analysed?—Not that I could not explode, but Dr. Haldane analysed some of the dust that we did explode.

18390. Have you met with dust that you could not explode?—Not coal dust. I have tried dust from a number of collieries in Wales and Yorkshire, and I obtained explosions from all of them.

18391. Even dust on the road?—I did not take it from under the roads; I took it generally and dealt with such dust as would be likely to be a source of danger.

18392. You have not dealt with dust on the roads?—No. As a rule it is so mixed with dirt it is almost impossible to separate what is coal dust from the dirt clogged up by the horses and men.

18393. A Witness from the Forest of Dean said the dust was almost absolutely harmless, and the analysis showed 46 per cent. of ash?—A very inferior coal.

18394. Or the dust is mixed up with something which is not fair coal dust?—That is it.

Digitized by Google

18395. Am I right in assuming at the present time the only way in which the Acts of Parliament deal with dust is in connection with shot-firing, and there is no provision in any Act of Parliament for the removal of dust or rendering it harmless except in connection with shot-firing?—That is so.

18396. Do you suggest that dust ought to be dealt with *per se*?—I do.

18397. You think the time has come when arrangements should be made by which the dust should be either removed or rendered harmless, whether you have shot-firing or whether you have not?—I do.

18398. You have been asked by Mr. Cunynghame whether you would suggest there should be an obligation to clean or to water. Might there not be cases where you could neither do the one nor the other?—I cannot conceive a case where you could not clean.

18399. There are cases where you could not water—that is quite clear?—Yes.

18400. Do you think you could sufficiently clean an ordinary road in a mine as to leave such an insufficient quantity of dust as to be non-dangerous?—I do.

18401. How would you do it?—If it was a road where there were a timber roof and bars where a large amount of dust collected I do not see any difficulty at all in a man sweeping across the top of the bar and bringing down any dust that might have accumulated, and then filling it by means of a shovel into a tub off the floor.

18402. You know Mr. Fowler's collieries, I daresay?—Yes.

18403. Have you been there?—Yes.

18404. Have you seen the arrangement he has for cleaning?—No. I have been there, but I have not seen that.

18405. You know he has a specially prepared zone?—I have heard so.

18406. Is that necessary?—I have not seen it, and I do not know the conditions under which he has carried it out.

18407. Do you think you could get all the dust from behind the bars?—I think you could to a very great extent. I do not say "all," but you could get a very large proportion.

18408. I suppose it is not known how small a quantity of dust is dangerous?—You must have a certain quantity.

18409. You think you could remove in an ordinary road sufficient by brushing so as to render what was left not dangerous?—Do you mean not be dangerous to fire a shot in?

18410. No; I mean if there was an explosion that it would not continue the explosion?—I think you could remove the dust in a main road so as to render to a very great extent the possibility of an explosion being carried down it.

18411. It would be useful to have experiments by which it could be distinctly shown how little dust would be dangerous?—I think it would be most useful; and, if I might suggest, the experiments might deal still further with this question of "safety explosives."

18412. Where do you get the term "safety explosives"?—It is a sort of generally accepted description of them.

18413. Do you not think it is rather a mistaken description?—I think so. I have a number of photographs I have taken from time to time of a good many of them, and there is certainly a flame with every one.

18414. Do you not think that description is rather misleading?—I think so. There are a large number upon the market, and the onus is thrown upon the manager. From time to time some explosives are withdrawn and others put up. I think all explosives used in collieries ought to be used with a Government certificate or stamp, so as to remove the onus from the manager.

18415. And call it "permitted explosive" and not "safety explosive"?—Yes.

18416. Do you think there is an impression on the part of the workmen and repairers that these explosives are perfectly safe?—There is such an impression. I would not let any be used unless the same precautions were taken as in using gunpowder.

18417. You think it may mislead the workmen and repairers because they are called "safety explosives"?—That is so. I may say on that point I constantly hear "Well, I consider so-and-so the safest of these."

18418. I want to call your attention to the Coal Mines Regulation Act, 1887, Rule 12, Sub-section (*h*) of Sub-division 2: "In the case of places in which watering would injure the roof or floor unless the explosive is so used with water or other contrivance as to prevent it from inflaming gas or dust, or is of such a nature that it cannot inflame gas or dust." What do you understand that to mean?—I understand it to mean that the explosive itself either has to be of such a nature that it cannot inflame gas or dust, or it has to be used in conjunction with some appliance which will bring about the same result.

18419. Do you know of any explosive that cannot inflame gas or dust?—No.

18420. You would conclude in the absence of such an explosive that where a shot is fired at the face watering is required?—Or the explosive used in conjunction with the watering contrivance or some other appliance.

18421. That does require that wherever the shot is fired, whether at the face or in the road, if it is dry and dusty, precautions must be taken either by watering or other contrivance to prevent it from inflaming gas or dust?—That is part of a main haulage road.

18422. No; you see Sub-section (*h*) is "If the place where a shot is to be fired is dry and dusty"—the haulage road comes later—"then the shot shall not be fired unless one of the following conditions is observed." That is, there must be water if the place is not already damp, or that the explosive must be of such a nature that it cannot inflame gas or dust?—Yes.

18423. That provides clearly for precautions being taken at the face if it is dry and dusty?—Yes.

18424. The next clause refers to haulage roads?—So I observe.

18425. Do you think generally that those existing provisions if carried out are sufficient to secure safety in shot-firing, or is there anything else which you would suggest in addition?—If a shot is absolutely necessary; it is almost impracticable to carry them out in some cases.

18426. Then, of course, if you could not carry out the regulations you would not have to fire the shot?—No.

18427. Can you suggest any additional regulations? It has been suggested here that no shot in the haulage road should be fired except under the immediate direction of the manager. Would you consider that a desirable addition?—Yes; I do not see any objection to that at all.

18428. Do you think it desirable to prescribe the interval in the case of a shot miss-firing, before you should go to it?—I think unless an interval is prescribed there is always the risk of a man going forward to examine his shot sooner than he should have done.

18429. You think it would be desirable to prescribe an interval?—I do.

18430. What would you suggest?—I suggest half-an-hour where shots are fired by electricity and with detonators.

18431. You think it would be an advantage to do that?—I think it would.

18432. Do you think it is desirable to prescribe any further detail as to the preparation of the shot so as to guard against a blown-out shot?—I do not see very well how you can; because you cannot lay down hard and fast laws as to the direction in which a shot should be drilled. Of course shots are put in such a position at times as to practically give every inducement, so to speak, for a blown-out shot.

18433. That is the great danger?—It is the danger.

18434. You often at times have shots really prepared and the hole is drilled in a way almost to invite a blown-out shot?—That is so.

18435. Is it desirable that some rule should be established to prevent that?—I think the manager ought to be responsible for that.

18436. The hole is drilled generally by the workman, is it not?—Yes, but I think the manager should give such instructions to his shot-lighters as to prevent their firing the shot except the hole is drilled in such a way as to obviate so far as possible the likelihood of a blown-out shot.

18437. There is no rule at present?—There is not.

18438. Do you think it would be desirable that, either in the form of a General or Special Rule, that should be provided for?—I think it should. I know of cases now where there is a parting about 18 ins. above the top of the coal. If a vertical shot is put in just up to that parting

Digitized by Google

Mr. C. E. Rhodes.

1 May, 1907.

for ripping, it spelches it off up to the parting. It is a very convenient thing for the man doing the ripping, but it is a shot, which, in many cases, unless very carefully dealt with, will be a blown-out shot.

18439. Therefore you think it desirable there should be some regulation to secure, so far as possible, that the hole was properly prepared?—I do.

18440. You have seen the German mines?—I have not.

18441. Your son has?—My son has been through the German mines many times.

18442. You say you have seen some arrangement to prevent dust going down the pit?—Yes, I am putting up some now at three large collieries.

18443. What is the character of the arrangement?—A fan that collects the dust through a series of tubes, each tube being connected with the tipping arrangement at the screens and the dust is collected by passing it through the fan and depositing it in a settling chamber.

18444. You have not had an opportunity of seeing the result of that?—I have seen the result at Mr. Chambers' collieries at Denaby.

18445. Is there an improvement?—Distinctly, and at new collieries I have recently put down I have put the screens a considerable distance away from the pit top.

18446. Your view is that there should be Special Regulations with regard to dust. Hitherto they have been confined to gas?—Yes.

18447. Would you see any objection to a rule or a regulation that it should be the duty of the managers, so far as practicable, to see that an accumulation of dust was prevented?—I do not see any objection to that rule; indeed, I think it would be an advantage to have a rule of that sort.

18448. You do not think that would be harassing or very expensive?—I do not.

18449. With reference to zones, do you think it would be desirable there should be protected zones required, so as to prevent an explosion extending if there was an explosion?—There should never be objections to additional precautions.

18450. I understand you would leave to the discretion of the manager the character of the precautions he would give to the zone, whether watering or cleaning?—Certainly.

18451. Would you also leave to him the discretion as to the length of zone and its position?—Yes, with a minimum.

18452. Would you make the minimum sufficient, or describe it more in detail?—I think I should make it a minimum.

18453. Do you think the vacuum cleaner which you have referred to would extract the dust from the goaf?—I think it would extract it from a certain distance in.

18454. I understood it took it only some two or three inches from the nozzle. Does the one you refer to do more than that?—It extracts it I think from a couple of feet.

18455. You think that might be useful?—I think it might, but I should prefer to avoid expressing a definite opinion until I have had further experience of it.

18456. You strongly recommend that experiments should be made with the view to ascertaining the character of the dust, whether the dust itself is explosive, and the distance of zone at which it might be stopped by watering or cleaning. You think it is desirable to experiment to ascertain that?—I think it is impossible really to overvalue their importance.

18457. Have you had any experience of rescue apparatus?—Yes, I have tried most of the past and present apparatus. Years ago I experimented with the old Fleuss apparatus.

18458. Do you think it would be desirable there should be these experimental stations in various parts of the country for the purpose of experimenting with the apparatus and training men to the use of them?—I think it would be desirable. We are arranging to do it at several collieries in South Yorkshire now.

18459. Have you had any experience yourself in the case of an explosion where you think life might have been saved if there had been in existence some such apparatus?—No. I have seen instances where property would have been saved, but not where life would have been saved.

18460. You recommend the establishment of these stations for the purpose of testing the apparatus and training men to the use of them?—Yes. I may say I have seen instances where their use has been of very great advantage in obviating the risk of life in re-opening a colliery. Just recently I used the pneumataphor to open up a colliery which had been shut on account of a fire, sending men forward on short stages to see the condition of things, and before establishing ventilation without rushing it through the mine; and were consequently able to move forward gradually without any risk.

18461. (*Mr. Smillie.*) And there may have been loss of life in that instance had you not so used it?—That is so.

18462. Do your shot-firers bore the hole and stem the shot?—The collier bores the hole, but the shot-firer stems the shot.

18463. You suggest the shot-firer should not fire a shot if in his opinion there was danger of a blown-out shot?—That is so.

18464. If he does not bore the hole or stem the shot, how can he tell?—He does stem the shot.

18465. And to that extent he would know whether the shot was in a dangerous position to be blown out?—Yes.

18466. So that, as a matter of fact, not only should he not fire the shot, but he should not stem the shot if it was bored in the solid?—Yes, he should refuse to fire it.

18467. Or stem it?—He should refuse to stem, and then the collier would be told that his shot would not be fired for that reason, and then his time would be wasted, and he would not put one in a similar position again.

18468. Why do you object to the term "safety explosive"? Is it because so far as you know there are none of the explosives really safe explosives?—I think it is a misnomer. The so-called "safety explosives" or high explosives have conduced enormously to the safety of shot-firing in mines, but to say they are safety explosives I think is misleading, and might make their reckless use more likely than if they were simply called "permitted explosives," to be used under the precautions set out in the Mines Act.

18469. If it was proved scientifically and by practice that they were safe, there would be no objection to their being called "safety explosives"?—I should be very glad to have them called "safety explosives" then.

18470. You are aware that in the Mines Act the expression "safety lamp" is used?—Yes.

18471. Do you know of any lamp that is absolutely safe?—I do—if it is in perfect order.

18472. And under certain conditions only, is it not?—I have a lamp now that will stand an explosive mixture of gas and air at a velocity of 100 ft. per second.

18473. Is a greater velocity than that possible?—I do not know of one.

18474. I think it is agreed that the safety lamp as understood by the Mines Act is not recognised as being absolutely safe under certain conditions?—That is so. The Mines Act simply provides that the lamp shall be capable of withstanding the highest current prevailing in any part of the mine, even if that current was of an explosive character. That is so far as the Act goes at the present time.

18475. It might as readily be called a permitted lamp as certain explosives are called permitted explosives?—Quite so.

18476. Do the coal-getters in Yorkshire convey their own timber and bars to the face?—It has to be kept within a certain distance, and in a great many cases the collier takes it in, perhaps, 20 or 30 yards, and in some cases rather more.

18477. You suggest for that 20 or 30 yards if the roof is not sufficiently high to get the tubs in with the bars on the top of the tubs, they knock out boards?—I have seen it done. I do not say it is a regular practice, but I have seen it done.

18478. Was it absolutely necessary that it should be done in order to convey their bars to the face?—Well, they would have had to have carried them.

18479. And you do not presume that colliers should be required to carry their bars 30 or 40 yards?—No.

18480. Would it not be possible to have tubs without ends in them for that purpose?—There are such tubs, but they are not always available.

18481. Is it not your duty to have them available?—I say it is only an exceptional thing, and I simply gave it as an illustration of the way in which a tub might be damaged.

Digitized by Google

18482. Would that mean once in a tub now and then ?—It is not a general thing, and I should not suggest it was.

18483. It would not contribute a great deal to the dust ?—I should say the extent to which it would contribute is infinitesimal.

18484. Your objection to spraying the tubs is not because that spraying would injure the coal as a marketable commodity, but because it would tend to silt up the riddles on the surface ?—Yes.

18485. Do you know whether or not the spraying tops of tubs, should it be necessary to do so, would injure the marketable value of the coal in Yorkshire ?—I do not think it would.

18486. It would not break it up ?—No.

18487. The nature of the coal would stand the spraying ?—Yes. A great deal of the small coal in Yorkshire is washed.

18488. Do you know whether or not their abandoning the riddle has tended to increase the amount of dust on the roads, or to lessen the quantity of dust on the roads ?—I think it has tended to increase the quantity of dust on the roads.

18489. I take it that since you abandoned riddles you have less dust which would be dangerous dust ?—That is in the pits generally.

18490. Left in the gob ?—Left in the gob, but I think it is more on the road.

18491. I understood that would be so, but I wanted to get it clear. Since you have begun to fill whole coal, small and round, there is a greater likelihood of its being deposited than there was previously when you put the dust in the gob ?—I think there is in the road; I should not like to say on the timbers.

18492. It is suggested here that most of the fine dust on the timbers and sides is blown off the tubs in conveyance to the pit bottom where the air-current is strong. Do you agree with that ?—I do not altogether. I think a great deal of that accumulation on the timbers is due to a number of causes. Tubs have been known to tipple over and have accidents to them, and things of that sort, and for the time being there is a quantity of dust which is swept forward by the air-current and deposited on the timbers. But I do not think, as a rule, in Yorkshire at any rate, the coal is filled in such a way as to have any small that is worth speaking about on the top of the tubs. Nearly all the tubs are well topped up with large lumps and all the small is underneath.

18493. And in the event of a wreckage taking place and coals being knocked about the roads, unless they were carefully picked up they would be ground up ?—Yes.

18494. And that would create dust which might rise ?—Yes, that would create dust which might rise.

18495. Is there really any danger from the dust which is in the gob. Is it not placed in such a position as to make it impossible that it could be put in suspension by the force of an explosion ? Is it not carefully stowed away ?—You see, you have always got in some mines a certain amount of open space back in the gob. Following every shot there is a vacuum created, and if there is a large quantity of dust present in the gob, or scattered about, it might be drawn forward to the point where the shot is being fired.

18496. I think you had in your mine places near the face ?—Yes.

18497. Your fear would be from the coal back in the haulage roads a long distance; there could be no danger arising from dust in the gob ?—That is so, because the packs would be so tight and the subsidence would be so complete that the roads would be practically in the solid, and there would be no communication between the roads and the goaf.

18498. I suppose I may take it that colliery owners and colliery managers and workmen generally have not been so very much afraid of dust in the past as they have of explosive gas ?—That is so.

18499. They accepted the danger of the one and they did not recognise the danger from the other ?—That is so.

18500. May we take it that large quantities of dust have been allowed to accumulate in collieries in the past, because of the fact that it was not feared as a danger calculated to cause an explosion ?—I think you may take that as a fact.

18501. And that if the danger from coal dust is fully recognised as it is now becoming recognised, there will be more care taken to prevent accumulations of dust in main haulage roads ?—I am sure of it.

18502. And greater care is being taken even now ?—I am sure of it, from my own knowledge.

18503. (*Mr. F. L. Davis.*) I did not quite gather from you whether you thought zone watering was practicable in a colliery?—I think it is practicable.

18504. For the reason which you gave, namely, that the zones should each be several hundred yards long, you could not have very many of them in a pit ?— No. When I spoke of zones several hundred yards in length I did not mean a watered zone; I meant a zone absolutely clear of dust, and damp to such an extent, that it would prevent dust passing through it, but not saturated with water.

18505. We have had other witnesses state that with a wet zone it should be 100 yards long, and with a dry zone possibly 200 yards ?—I do not think anyone really can express an opinion until we have had more information on the subject. I should not like to express an opinion definitely one way or the other, but I think that to rely at the present time upon a short length of zone might be found to be relying upon what you would find later to be unreliable.

18506. In answer to Mr. Ellis you said that in firing shots you would suggest allowing half an hour between the firing of two shots ?—No, I meant a half-an-hour interval in case of a shot missing fire.

18507. Supposing you had four or five shots to fire in one place, you would only advise firing one shot at a time ?—That is so.

18508. How long would you allow to elapse between the first and the second shot in that case ?—I think as soon as the first shot had gone off the man could go forward, examine his face, and see that all was safe, and then stem his second shot after he had examined all round and seen that everything was in order.

18509. Do you think that the after effect of a shot, when it has been fired, would be to stir up a good deal of the dust in the neighbourhood ?—Undoubtedly it would.

18510. I have heard it suggested by one or two colliery managers that it would be safer to fire, say, three or four shots all together than to fire one after another, because you would probably get more dust in the air after the firing of one shot so that the atmosphere would be more dusty when you fired the second shot ?—But if the air was travelling at such a velocity as to ventilate the working place the atmosphere containing the dust would be cleared away within almost a very few minutes of the shot being fired.

18511. In your opinion, if dust were stirred up by the first shot, after a certain reasonable time, say 10 minutes or a quarter of an hour, the ventilation would have carried away the dust ?—It would have carried it away almost at once; if it was travelling even at the rate of 5 or 6 feet per second it would carry it away.

18512. With regard to the dust collecting at the top of the pit, in your colliery are the shafts all dry ?—No, some of them are wet, but still the dust goes down those wet shafts. You see you get a velocity of the air in some of those shafts up to 2,000 feet, and the air carries the dust down the centre of the shaft and it does not get damp.

18513. It does not even fall into the sump ?—No, it goes straight in the air current; it is such an impalpable powder that it is practically carried in the air-current; and if you stand at the pit bottom and hang a sheet of newspaper up 30 or 40 yards away from the pit bottom, and further in-bye than that, you will find it will get covered with an impalpable powder in a surprisingly short space of time, and that for a very considerable distance in the pit. Anyone going, say, 500 or 600 yards away from the pit bottom and standing in the air-current and then coming out and looking at his face will very soon see that there is in the air a very considerable percentage of dust being carried at some collieries.

18514. Do you think that would be so, say, in a very wet shaft ?—I should not like to say that it would be the case in a very wet shaft or in a very small shaft, but where you have shafts such as some of those I have, up to 24 feet in diameter, even if the sides are damp, and you have 3,000 feet of air going down, the air in the middle is practically unaffected by the size.

18515. So that you think that even in wet shafts a certain amount of dust does go down from the screens and gets into the air-current ?—I think it does.

18516. I think you said you had here some photographs of shots fired with these permitted explosives ?—I have.

18517. Do they show the flame ?—They show the flame.

Digitized by Google

Mr. C. E. Rhodes.

1 May, 1907.

18518. (*Dr. Haldane.*) These are unstemmed shots?—These were stemmed in the pit and we had them fired in a stone drift, and the shots were fired so as to fire them directly as far as possible across the drift, and then we took photographs. We did that in connection with permitted explosive when they were first brought out; I experimented with them all and took photographs of the gunpowder flame and the flame with the permitted explosives. I have a number of the photographs here, but unfortunately I have lost or mislaid another pocket-book containing some (*the witness produced photographs*). I had several books filled with the same sort of photographs, and they were all pretty much alike in result, from the permitted explosives.

18519. (*Mr. F. L. Davis.*) Were any of those with a water cartridge?—We took some with water cartridges and with cartridges which were made up of gelatine from seaweed, and also with cartridges made up with damp cloths, but unfortunately I have lost the pocket-book containing those photographs. We did get some explosions then without any flame at all; and with the cartridges made up with a soap covering very much like Irish moss jelly we got no flame at all. But we found the difficulty of making a cartridge which we could carry about and hand out to the colliers an insuperable objection; we tried very hard to introduce a cartridge which we could use successfully. I used the water cartridge for a long time, but we found there was very great difficulty with that, from the carelessness of the men in putting the bag in with the water and causing it to burst; we found that instead of being an advantage it was rather a disadvantage.

18520. (*Dr. Haldane.*) Are your experiments on explosions of coal dust and admixtures of coal dust and fire-damp described in the evidence of the last Commission?—Yes.

18521. They were made in that boiler which you had at Parkgate Colliery, were they not?—Yes,—which you saw; it was the same series.

18522. And you are perfectly convinced that the admixture of a certain percentage of fire-damp with the dust very greatly increases its liability to explode?—That is so, seeing that we got the most violent explosions in that way; you will remember we could not get any with the coal dust by itself, but with just an infinitesimal trace of gas we got that tremendous explosion which blew all our safety apparatus all over the main line.

18523. Yes, I remember the things flying all over the place. I forget what percentages of fire-damp you used?—We got a percentage that we could not trace even with an alcohol lamp, you remember.

18524. It was less than 1 per cent.?—Yes, less than 1 per cent.

18525. And that amount increased the explosion?—It increased the explosion to a very great extent. All the later experiments that we made were with a percentage of gas that we could not trace with an alcohol lamp; it showed no elongation of the flame and no trace at all, and we kept it at that point.

18526. One of the points referred to this Commission is whether some maximum standard of the permissible percentage of firedamp in mine working should be established; that is one of the terms of reference—standard of ventilation?—It is a most difficult question.

18527. It is a most difficult matter, but your experiments seem to indicate that it is of great importance in relation to dust as well as to pure firedamp?—Undoubtedly—where shots are to be fired. But the percentage of gas which in itself would be absolutely innocuous and harmless even with dust, if there were no shots fired, would become tremendously harmful with a shot. I know some of the Silkstone collieries where the ventilation current is, I might say, absolutely abnormal, and even then we cannot prevent a continuous percentage of gas in the returns, which can be detected every day in an ordinary safety lamp.

18528. Is there ever that percentage at the face?—No; but as soon as you ever get into the return it is there.

18529. Probably that comes from the goaf a good deal?—It comes from the mine as a whole, and almost entirely from the face because the goaf makes up so absolutely tight.

18530. Then you must have that gas in the air at the end of a longwall face if that is so?—At the last end of the face we begin to find a trace which becomes accentuated as it mixes with other returns from other districts.

18531. In these collieries you do not blast?—We do not blast at all, and, as I say, we have taken the electrical signalling out of any roads where there are return airways and we do not allow the men to travel in the returns. But those are extra precautions taken on account of the peculiarly fiery character of the mine.

18532. You do not work to any strict standard in regard to ventilation, I suppose; I mean supposing you see a distinct cap in the returns you take extra precautions, but you do not attempt to increase the ventilation so as to get rid of that cap?—Well, we cannot increase the ventilation, because we have reached the maximum amount that we can get through the mine.

18533. That is only a question of the size of your roadways and the power of your fans, is it not?—Of course you could go on increasing the size of the roadways and increasing the size of the fans until you could get almost any quantity of air, but it would reduce the working of collieries to an impossibility in some cases to do it.

18534. I quite see that; or you would have to reduce the output, which would come to the same thing?—It would come to the same thing.

18535. But you are of opinion that where there is a lot of gas at the working face additional precautions with regard to dust are particularly necessary?—I think so.

18536. The matter seems to me to be very important in connection with Welsh collieries, and that is why I am asking particularly about it?—Yes.

18537. As you are aware, there is very often a great deal of gas to be found at the working face in Welsh collieries, and the explosions are particularly violent, and they pass through the working face there?—Of course I have not an intimate acquaintance with Welsh collieries.

18538. As a general rule you are no doubt aware that an explosion, say in Yorkshire, or in the North of England, if it does occur, does not affect the working face?—That is so. There are very few collieries that I am conversant with in which it is possible to find a trace of gas that can be detected by an ordinary safety lamp in any face; it is an extremely rare occurrence to find a trace of gas in that way. Of course, with an alcohol lamp, where you can test down to a very low percentage, there would be a trace found because it is utterly impossible to carry any such quantity of air into an ordinary colliery as to make that air absolutely such a quantity as to reduce the percentage of firedamp to an untraceable point.

18539. Yes, but as a matter of fact whether firedamp is present or not in the working face, an explosion which has started in a haulage road does not usually extend to the face?—That is so; as a rule it will feed itself by going in the direction of the fresh air.

18540. But, on the other hand, in a Welsh explosion—I do not know whether you are familiar with the records of them—the explosion traverses the face?—As a rule the shots are fired in the face there, I presume.

18541. Very often they are?—And the explosion might have been initiated in the face.

18542. Well, that is the whole point. When you fire a shot at the face in mines in Wales there seems to be some risk of an explosion very often; whereas I do not know of any case of an explosion which has initiated at the face in Yorkshire?—I do not. Of course we have been very fortunate in not having had any explosions for a large number of years. But, as I say, the use of explosives is reduced to a very small quantity in Yorkshire as a rule.

18543. In the case of ripping shots which you were referring to, these are all done pretty near the face, are they not?—Yes, they are done within 20 or 30 yards of the face—even the back ripping.

18544. In that zone of the mine, so to speak, at the very beginnings of the roads there is very little dust?—There is very little dust there as a rule.

18545. And actually if an explosion has started in a main haulage road it would usually die away before it got to that part of the mine?—I think it would.

18546. That has been so in various explosions, I take it—in the case of Altofts or Micklefield?—That is so.

18547. That is so as a matter of fact; so that these ripping shots are not such a formidable problem as firing shots on a main haulage road?—No. I simply wish to emphasize the necessity of supervision being applied to all shots so as to prevent if possible a blown-out shot taking place through the carelessness of a man.

18548. I quite agree that it should be made as safe as possible. But there is evidence that in many Yorkshire

Digitized by Google

collieries, at any rate, it is very dangerous to fire a shot on a main haulage road ?—That is so; but it is a very rare occurrence that a shot ever is fired.

18549. That is the point which I am coming to now. Do you think it would be practicable to introduce a rule that no shots should be fired on the main haulage road except between shifts or at some safe time ?—No; it is rather difficult to say where a main haulage road stops, because it might be taken that every horse road, up into say a nest of working places, was a main haulage road for the time being. Those are the very roads where a shot has to be fired occasionally.

18550. Any rule that was made would have to make that perfectly clear. I quite understand that it is absolutely necessary to fire shots there and to fire a number of them in the case of some seams ?—Yes, because you get a second weight coming on which lowers the roof and the ponies cannot get up there, and it is absolutely necessary to have two or three shots put in in order to enable the men to work that road next shift.

18551. But with regard to a great many parts of England I do not know of any record of an explosion having been caused by shots of that kind ?—No.

18552. Whereas shots in main haulage roads are very dangerous, no doubt ?—There would be no difficulty in firing shots if the term "main haulage road" could be clearly defined, so that in firing those shots practically the whole of the men should be out of the pit. It could be arranged to fire those shots at week-ends or at some special time, and such precautions should be taken as to make it perfectly safe to fire them.

18553. With regard to damping when such a shot is fired as you refer to, do you think that damping as it is carried out in practice is really efficacious in preventing a cloud of dust ?—No, I do not think it is. The damping according to the ordinary practice does not spray the surrounding strata, so as to prevent dust being carried, and the only way in which it could really be done would be by having some small movable water tank, with water under pressure, by which a spray could be thrown over the whole of the strata 20 or 30 yards; but by the process of taking it in a bucket, as has to be done in a great many cases, they cannot do that.

18554. That is what occurs to me—that in practice that precaution is not a thing to be relied upon ?—In some cases they use fire extinguishers, but that is in exceptional cases, where they go to considerable expense and use the chemical and the pressure in order to get the necessary spraying force.

18555. That is a very small quantity of water to do the work of watering 20 yards of the road ?—Yes, it is a small quantity, but it does it very efficiently.

18556. But still, have you ever tested the efficacy of the watering before a shot is fired in any way; for instance, by going to the place and seeing whether you can blow dust from the sides of the road ?—I have not.

18557. I should think a simple test like that would be useful; I know how difficult it is to thoroughly damp the dust ?—Yes.

18558. With regard to rescue apparatus, you express the opinion that such apparatus would more often save property than life ?—Yes.

18559. I can understand that in the case of districts where gob fires are frequent it would appear to be of great use; but in Yorkshire, for instance, I think gob fires are very infrequent ?—Very. But we have had cases of fire where if we could have got men working with hoses up to the seat of the fire, without taking the air with them, we could have got the fire out.

18560. And you think that from that point of view it is worth while using them ?—Yes; and also from the point of view of knowing that you have a certain percentage of your men trained to the use of hoses and other similar appliances which are available; I think from that point of view alone it is desirable that those stations should be in readiness for use.

18561. In the case of accidental fire it is usually necessary to deal with it very quickly and promptly, is it not ?—That is so.

18562. In that case it is desirable that the men should be at the colliery, and should have their apparatus available very promptly, is it not ?—Yes; I think that each colliery should be fitted up with a certain number of the apparatuses, and that the central station should be simply used as a training ground. That is what we are proposing to do in Yorkshire—to have a group of collieries established in the training ground in the centre from which you can get your charges to each colliery, and to have a certain number of the apparatuses on the spot, and then in the event of an accident they would use those first, and then be able to call on their neighbours and friends to come with additional apparatus.

18563. You are of opinion that it would not be satisfactory to have to wait, say, for an hour or two until help could be got from the central station ?—I think it would be ridiculous. To be of any service at all, you want it at once, or else the chance is gone.

18564. That would not apply to the same extent to an explosion ?—It would not.

18565. It is for ordinary cases, for instance an accidental fire, that you would want the men promptly ?—That is so.

18566. It is exactly like the case of a fireman; if he is on the spot soon that is of enormous advantage ?—Quite so; that is my opinion.

18567. I could quite understand that with regard to districts where gob fires are frequent, and they may involve a main road, that may be so; but I was not sure whether you considered it to be so for a district like Yorkshire ?—Yes.

18568. (*Chairman.*) It has been suggested to me, with regard to General Rule 4, which provides for inspection before beginning work—that the Inspector shall ascertain the condition of the mine so far as the presence of gas, ventilation, roof and sides, and general safety are concerned—whether it might not be as well to add to that General Rule that the Inspector should report whether or not the mine is free from dust. Might not that be one of the specific matters to which his attention should be directed ?—I think it would be of advantage that it should be included in his Report.

18569. That is to say, that he should state, "I have found that such and such a part of the mine was dusty," or "not dusty" ?—Yes.

18570. (*Sir Lindsay Wood.*) To what extent could that be applied in practice ? The fireman would have to report the mine free from dust: could it possibly be done ?—Supposing a man went round a certain district where precautions were in regular use for dealing with the dust, and he found that in one particular place the dust was accumulating, he would draw attention to that, and that accumulation of dust would be dealt with exactly in the same way that any other source of danger which he might indicate in his Reports would be dealt with.

18571. Would that be coal dust, shale dust, or what ?—It would be coal dust. Of course shale dust is, as a rule, dust on the floor and not the dust which is dangerous and which is now under consideration to a very great extent.

18572. Then that would have to be specified ?—The colliery manager would have to use his own judgment.

18573. So would the fireman: he would have to go round in the morning and inspect.

18574. (*Mr. Ratcliffe Ellis.*) But it would be a statement that the regulation, whatever it was, which was made at the colliery, was being complied with ?—That the regulation which was made at the colliery in that particular district was being complied with; that is my meaning.

18574A. (*Chairman.*) That is your idea—the regulation, whatever it might be, as to watering and so on ?—Yes.

18575. (*Sir Lindsay Wood.*) But dealing with it practically, supposing a fireman went along the long-wall face on any morning, could it be declared that there was no dust in that place ?—Yes, I think he could state that in a great many cases.

18576. In a dry and dusty mine ?—Yes, in a great many cases he could; but when he got round the corner and turned into the travelling road he would find dust.

18577. (*Chairman.*) Then would you suggest that he should report not so much the freedom of the mine or of the particular part of it from dust, but whether the regulations, which might be in force at that particular mine for dealing with dust, had or had not been complied with—that he should report in that sense probably ?—Yes.

18578. That he should say, "I have looked through a certain portion of the mine, and I find that the portions which ought to be watered are watered, and that the portions which ought to be cleaned from dust are fairly cleaned from dust," or something of that sort ?—Or, "I find that dust is accumulating in No. 2 travelling road"; and then the manager would have his attention drawn to that, and his staff would see that the dust was cleared and

Digitized by Google

Mr. C. E. Rhodes.

1 May, 1907.

the road kept right—exactly in the same way as if he reported the presence of gas.

18579. (*Mr. F. L. Davis.*) Of course the extent of the dust there would vary in different mines?—Certainly.

18580. What in one mine would be considered an accumulation of dust in another mine would not be?—That would be so, undoubtedly. Each mine would have to be dealt with on its own merits; and it seems to me that if common sense is exercised there is not very much difficulty in arriving at what is a reasonable amount, and what is not.

Mr. HENRY BRAMALL, called and examined.

STATEMENT OF WITNESS.

Mr. Henry Bramall.

18580A. I am a Civil and Mining Engineer and have been a Member of the Institution of Civil Engineers for the past 30 years. I have had 52 years' experience in the working and management of Coal Mines in Lancashire and elsewhere. For the past 20 years I have been the Engineer for the Collieries belonging to Messrs. Andrew Knowles and Sons, Limited, near Manchester, of which firm I am now Managing Director. The collieries owned by this company are extensive, employing upwards of 3,800 hands, and the mines worked lie at great depths, varying from 2,500 to 3,600 feet below the surface: probably on the whole the deepest coal mines worked in this country. It is from this point of view that I have considered the questions.

(1) I think it is practicable to diminish the accumulation of inflammable dust by rendering the pit wagons dust-tight. For nearly 20 years I have had in use at the collieries under my charge iron-bodied wagons, and find that they greatly diminish the dust on the roads, and as the mines are tolerably dry the cost of maintenance is only about the same as that of wooden wagons.

(2) I do not know of any practical method of covering coal wagons so as to prevent the escape of dust.

(3) I do not think spraying the tops of wagons would be effective. If the top of the coal in wagons is dusty, it would take more than a spray of water to effectively damp it. If enough water were used to be effective it would prevent the coal being properly screened on the surface and would prejudice its sale value. If iron wagons were used the water would injure and corrode them and by affecting the weight of the contents of the wagon would lead to disputes as to the correct weight for which the colliers should be paid.

(4) I have not come across any cases where it would be necessary to remove the screens or to collect dust from the screens by a fan to prevent the dust being carried down the pit, though I am told that there are such cases. I think dust in the winding shaft is more due to the transit of coal through it.

(5) If watering of the roadways is to be effective for the prevention of dust, I think it would be necessary to water the roof and sides as the dangerous dust accumulates on these places. Watering of this character in deep mines such as ours is impracticable. The effect would be to damage the roof and sides and to render the roads very dangerous; in fact, it would be almost impossible to maintain roads open at all.

(6) The temperature of mines at the depth we are working is very high, but the air is very dry, and it is this dryness of the air that enables the men to work. If by any system of watering either by jets or sprays the air were rendered humid or at all approaching saturation the efficiency of the men would be so interfered with that it would probably become impracticable to continue the working of the mines.

(7) With reference to the formation of dustless dry zones, arched roads could not be maintained in deep mines such as ours; they would be crushed out and require constant renewal. Possibly a length of road to form a zone might be plastered on the sides, and the roof covered with wood and the road by this means kept in such a state as to enable it to be occasionally swept. The dust on the floors of our roads so largely consists of shale as to be non-inflammable.

(8) With respect to shot-firing. The rules in the Lancashire District are comprehensive and stringent. At the collieries under my control no shot-firing is allowed except by competent men specially appointed, and all shots are fired by electricity. No person other than the authorised shot-lighter is allowed to have in his possession any explosive, detonator, cable, or battery. The collier or workman bores the hole for the shot, and the shot-lighter's duty is to examine the hole, and if he is satisfied with its position he charges and fires the shot and the collier is charged with the cost of it.

(9) In some of our deeper mines there is very little shot-firing, and before any shot is fired in any main haulage road special permission has to be obtained from the certificated manager, who in most cases makes a personal inspection before giving such permission. Such shots are fired between the shifts, or on Saturdays when the ordinary work is suspended.

18581 (*Chairman*). You have had 52 years' experience in the working and management of coal mines in Lancashire and elsewhere. Where besides Lancashire have you had experience?—I have been in North Wales, and I am the Managing Director and Chairman of a colliery in Leicestershire at present.

18582. So that you have had a good deal of experience outside Lancashire?—Yes.

18583. Both in Wales and in Leicestershire?—Yes.

18584. With regard to the question of dealing with inflammable dust you say it is practicable to diminish the accumulation of inflammable dust by rendering pit wagons dust-tight. Do you think that there is any difficulty in the introduction of dust-tight wagons: first of all, is there any objection on the part of the men; are they less easy to manipulate?—No, there is no difficulty whatever.

18585. You say you have iron-bodied wagons in use. It has been suggested to us by some witnesses that iron wagons are too heavy and that they are apt to be dangerous when they are running on inclines, because if they break loose there are more accidents from them than there would be from the lighter wagons?—I do not think so. They are very little heavier than the wooden wagons of corresponding capacity. I have here a sketch of the wagon we are using, which might interest the Commission. (*Witness handed in a sketch*).*

18586. That is the latest type of wagon?—That is the wagon which we have been using for the last 20 years. We have made no change in it during that period, or hardly any change.

18587. It has not got any open sides, but it is made with four closed sides?—Yes.

18588. It is not covered, I suppose?—No, not covered. That wagon costs about 45s. to make, and, taking the cost of the maintenance over a series of years, the last 10 years, I find that it costs about the same as wooden wagons cost.

18589. And that it is much more efficacious in preventing dust being shaken out?—Yes. Our roads are practically free from dust where we use those wagons—that is to say, on the floor.

18590. Are they expensive to keep in thorough repair?—The repair costs about 7s. per year per wagon.

18591. For thorough repair?—For thorough repair, maintenance and renewal.

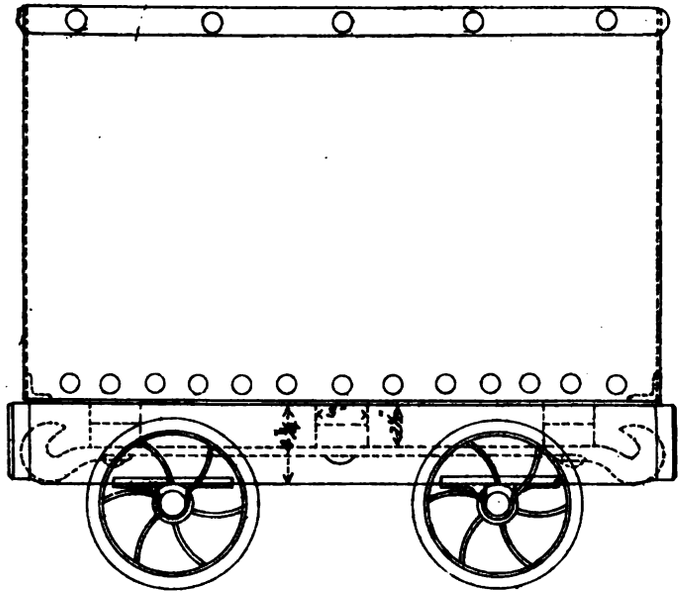
18592. So that having got these wagons there is no difficulty at all in preventing dust shaking out of the wagons, that hardly takes place at all?—That is so.

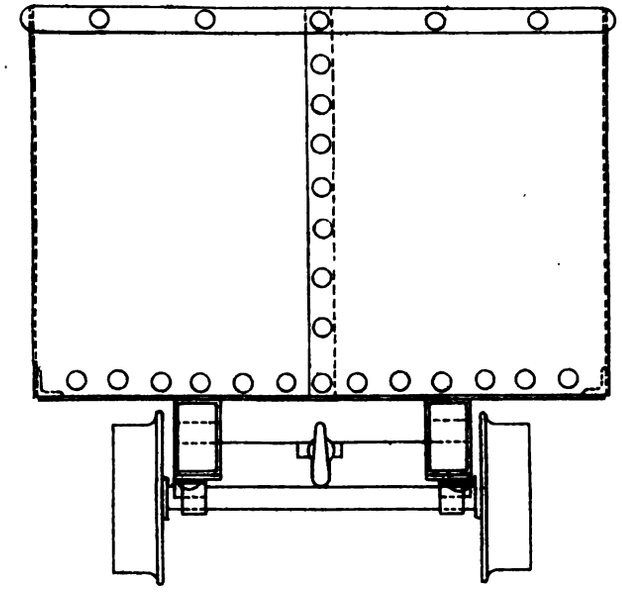
18593. I understand you do not care about spraying the tops of wagons; you say you do not think it would be effective?—I do not think it would be effective for the purpose of preventing dust. I have tried some experiments on that subject, but I could not keep the dust down by spraying with any reasonable quantity of water. I tried with an 8 cwt. tub of coal—a similar tub or wagon to that shown upon the tracing which I have handed in—and I found that five gallons of water sprinkled on the top of the tub would scarcely wet the dust at all, indeed, so little that when the tub had been drawn a few yards, the crust of dust which had been moistened had shaken loose, and the dry dust was exposed. So then I tried what I could do by saturating the coal, and I saturated a wagon, and I found that it took 12 gallons of water to saturate a wagon containing 8 cwt. of coal. That did keep down the dust and it saturated the wagon of coal, but we found that after the wagon had stood half-an-hour it still retained ¾ cwt. of water beyond the weight of the coal, and the coal which was in the wagon was completely ruined for sale; it was all caked together and we could not screen it, and we had to put it into our boiler fire hole. Then besides that there would have been considerable difficulty in weighing, because we could not keep the correct weight of the coal got by the men if we had to water it to that extent.

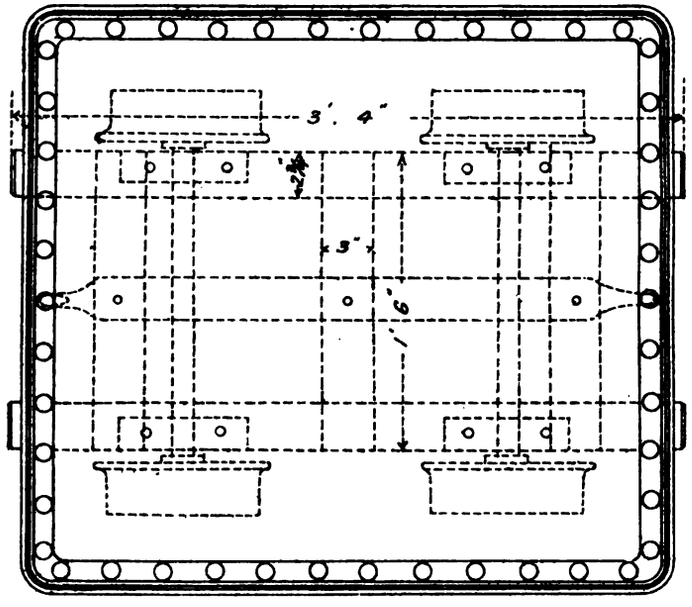
---

* Plate XIX.

Digitized by Google







IRON PIT BOX.

IN USE AT ANDREW KNOWLES & SONS COLLIERIES.

Scale of Feet.

INCHES 12 9 6 3 0 1 2 3 FEET.

DIMENSIONS.

Length inside	3 Ft 0 ins
Width	2 Ft 10 ins
Depth	2 Ft 0 ins
Side & End Plates	⅛ ins Thick
Bottom	3/16 " "
Top Hoop, Convex.	2 ins x 7/16 ins
Bottom Angle	2 ins X 2 ins X ¼ "
Rivets	⅜ ins Diam[r]
Underframe	Oak
Carrying Capacity	8½ Cwts.

Digitized by Google

Digitized by Google

18594. The weight would always appear to be more than was actually raised?—Yes—and a varying weight; we should never be able to agree with the men on the correct weight.

18595. You say it is not necessary to remove the screens or to collect dust from the screens?—That is only my experience. No doubt there are cases which are different from my experience, but I have not had any cases of that kind.

18596. In all the cases of screens which you are acquainted with it would not be in the least necessary to have fans in order to prevent the current of air going down the pit?—No; I think there is very little dust going down the pit from the screens in our case. I think what dust there is in the pit is shaken off the boxes by the vibration as the boxes are travelling up the shaft.

18597. You say that if watering roadways is to be effective for the prevention of dust, you think it would be necessary to water the roof and sides, because the dangerous dust accumulates on those places. Of course it would be better to water the roof and sides, but if the floor were thoroughly watered I suppose that would to a great extent prevent the accumulation of dust, because, by means of ventilation, dust would be constantly blown off the sides and roof and would fall on to the wet road? I should think it would be scarcely possible to keep a road in such a state of wetness that it would have that effect. Some of our roads we keep in a state of dampness, as you might call it, on the floor.

18598. But even supposing it was only slightly damp, would not the dust be mopped up by the damp on the floor?—I do not think so.

18599. You think that if the floor was only very slightly damp, the dry dust would accumulate on top of the damp and would remain dry?—It might. We have never practised watering the floor sufficiently with a view to keeping down the dust. The object has been chiefly to make the floor better suitable for the horses' feet; that is the extent to which we have had to practise watering.

18600. But where roof and sides prevent you from putting on any great amount of water, do you think it might be made slightly damp and the atmosphere rendered slightly moist by a system of sprays?—I should like to speak of that with reference to my own experience in working these very deep mines. There I think it would be a very disastrous thing to saturate or to attempt to saturate the atmosphere with moisture, because the heat is so great that it would interfere with the health and working of the men.

18601. Then, on the other hand, the sprays would to some extent, reduce the temperature?—No, the effect of that would be lost in a very short time. The dryness of the atmosphere is very great in those mines. I have taken numerous observations, and I may state that the dryness of the atmosphere is remarkable—it is as low as 35 to 40 per cent of humidity.

18602. But then if it is as low as that, surely it would be desirable for the health of the men that there should be a certain amount of moisture. Is it not almost too dry?—Not at that temperature.

18603. You consider that the health of the men would be affected, and that the sprays would hardly reduce the temperature at all?—That is so.

18604. You think that the effect would be that the atmosphere would be moister, and consequently more difficult to bear, and that that would not be in the least off-set by the very small diminution of temperature which might arise?—That is so.

18605. You go on to speak about dustless dry zones, and you say that arched roads could not be maintained in deep mines such as yours, but that they would be crushed out and would require constant renewal. Then you suggest that a length of road might be plastered, and the sides and roof covered with wood, and that the road by that means might be kept in such a state as to enable it to be occasionally swept. You have not tried that?—We have maintained roads in that way; we have had many hundreds of yards of arched roads which have had to be taken out and done away with, and the best way, we find, to maintain a road is to build the sides with the material that is got out of the roof—the shale or metal as we call it—in a kind of rough wall, and to cover over the top with steel girders, lining up the spaces with wood. That we find is the best road in our deep mines.

18606. You can keep the dust out of those?—I think it might be possible in a zone to plaster the sides of those roads.

18607. And at all events to keep a zone free from dust?—Yes.

18608. You say that as you get down to a great depth where it is very hot indeed, it is a danger to health to water at all, because the humid atmosphere is so bad for the men?—Yes—to water to such an extent as to make the atmosphere humid.

18609. Then you say you do not even like to spray it; you do not like to use any water at all down below, if you can help it?—I do not see that spraying would be very much good with a temperature like that.

18610. You say that where you reach a certain temperature it is very detrimental to the health of the men that there should be anything in the nature of watering carried out, and that in order to keep the men healthy and to enable them to work you must have a perfectly dry atmosphere, or as nearly dry as you can?—That is our experience.

18611. That is your experience, you say. Have you any statistics to show that the men are much more healthy in these deep mines when the atmosphere is quite dry?—I have not any statistics, but if by any chance we have a little wet in the mine, we find out directly that the men cannot stand it.

18612. How do you mean they cannot stand it; do they become ill?—They cannot work.

18613. Is there anything worse than their not being able to work; do they become ill as well as not being able to work, or being able to do only very little work?—Well, I do not know that there is anything much worse.

18614. Then they go out of the mine, I suppose?—Yes; there is nothing much worse for a working man than to prevent him or incapacitate him from working.

18615. You say that it does incapacitate them from working?—It does.

18616. Whether or not it makes them ill?—Yes.

18617. What is the temperature in your mine in which you say this occurs?—The temperature is about 92 deg. to 98 deg. at the hottest point.

18618. At what depth?—That is at a depth of about 3,600 ft.

18619. It goes up to 98 deg.?—Yes.

18620. In a temperature of 98 deg. I suppose a man could hardly work at all unless the atmosphere is perfectly dry or very nearly quite dry?—That is so.

18621. With reference to shot-firing, you say that the rules in the Lancashire district are comprehensive and stringent. We have had those rules before us, and you state what the rules are. Are you satisfied with the rules as they are carried into effect in the Lancashire district; do you think that they can be strengthened, or that they ought to be strengthened in any way?—I would not say that they are perfect, because we ourselves in our practice go a little beyond the rule.

18622. Will you tell us in what respect you go beyond the rule?—In the first place, we do not allow any explosive to be taken into the pit by anyone except a shot-lighter; we do not allow any of the workmen to handle explosives at all; the only thing that a workman can do is to drill the hole and prepare it for the shot, and then he must send for the shot-lighter. The shot-lighter brings with him all the apparatus, the explosive, the detonator and the electric apparatus, and the shot-lighter himself charges the hole and stems it and fires it, and sees that all the necessary precautions are taken.

18623. That is not provided in your rule; it is not necessary, according to your rule, that the shot-firer should take down the explosives and the detonator?—No.

18624. So far as the rules are concerned, the men might do that?—Yes, I am not aware that it is the practice at any other colliery besides our own to do what I have just said, although it may be.

18625. But would you suggest that it might be made a general rule that nobody except the shot-firer should be allowed to handle the detonators and explosives at all?—I think it would be a very good thing to provide that only the shot-firer, the authorised person, should handle the explosives.

18626. You think that might very well be made a general rule to apply to all coal mines?—Yes. In that way we have the control of the explosives; we purchase the explosive and we know what explosive is being used.

18627. Perhaps you might get the control in other ways;

Digitized by Google

Mr. Henry Bramall.

1 May, 1907.

you might make the ordinary collier buy his explosives from you—in fact, in many cases they are obliged to buy the explosives from the manager, I think ?—Then, again, we know who has the explosives.

18628. (*Mr. Ratcliffe Ellis.*) I think what the Chairman has put is the arrangement which you have, is it not ?—No, we do not allow anyone to have any explosive, except the shot-firer.

18629. (*Chairman.*) But you might get that result short of prohibiting anybody but the shot-firer to be handling explosives ?—We should have this difficulty; we should not know who had got explosives in the mine, whereas we do now know who has got explosives.

18630. Except that the shot-firer might go down in breach of the rule and give the detonator or the explosives to someone else—but that would be a breach of the rule ?—That would be a breach of the rule.

18631. At all events, you think that the shot-firer should be the only person who should be allowed to have the detonators and explosives, and that it should be an offence for anybody except the shot-firer to have them in his possession ?—That is our practice.

18632. That is your practice, and you think it might be made a practice everywhere ?—Yes.

18633. Before any shot is fired in any main haulage road, special permission has to be obtained from the certified manager: that is under your Special Rules ?—Yes.

18634. And the manager in most cases makes a personal inspection before giving such permission ?—Yes.

18635. Would you say that in every case he must make a personal inspection, or might he go by the report of the under-manager or someone else ?—I should not say that the certified manager should in every case make a personal inspection, because our practice with regard to that again is a little different from the practice in some collieries. We have a certificated manager at every colliery, but in some cases the certificated manager has the control of a number of collieries.

18636. So that it would not be possible for a certificated manager in every case to go down and examine the place ?—No, but the under-manager might.

18637. The certificated manager can give special permission, but, of course, he may give that special permission on the report of someone else ?—Yes.

18638. He might, so far as the Rule is concerned, give it on the report of an ordinary collier, but I suppose he would not do so: he himself would be responsible ?—Our practice is that either the manager himself or the under-manager should inspect the place before the permission is given to fire the shot.

18639. Would you consider it reasonable that that should be made a General Rule also, and that in no case should a shot be fired—at all events in a main haulage road—without the manager or under-manager having, shortly before the shot was fired, inspected the place ?—I think it should be made a rule that he should inspect the place and give permission in writing.

18640. That either the manager or the under-manager should do so ?—That either the manager or the under-manager should do so.

18641. That he should only give the permission after having inspected the place—that is the point ?—Yes.

18642. (*Sir Lindsay Wood.*) You have said that you use iron tubs in your mine ?—Yes.

18643. Do you think that there is any preference between iron and wood, so long as the bottoms and sides are kept tight ?—In mines which are as hot as ours, it is impossible to keep wood tubs tight; shrinkage takes place in the wood, and when you have mines at a temperature of 90 degs. to 98 degs. there is sure to be shrinkage of the wood.

18644. But that is rather an exception ?—Yes

18645. There are not very many mines so hot as 98 deg. ?—I do not know of any except our own, and I do not know of any mines so deep.

18646. Is that due to declivity, or are the shafts so deep ?—It is due to declivity. The shaft itself is only about 515 yards deep.

18647. (*Mr. Wm. Abraham.*) Are we to understand that these seams could be reached from the surface by a shaft of a depth of 515 yards ?—They were reached at that time at that depth, but that shaft was sunk 60 years ago, and has been working continuously ever since, the mine being followed to the deep, so that now the whole of the coal is exhausted down to a depth of something like—I should think the shallowest coal in that pit is 2,800 feet deep.

18648. The slant is that length ?—The slant is that length.

18649. (*Mr. Ratcliffe Ellis.*) What would be the depth from the bottom of the slant to the surface—the lowest part ?—3,600 feet.

18650. (*Sir Lindsay Wood.*) What is the system of ventilation there ?—Fan.

18651. Then you get a considerable assistance in the ventilation by the workings being to the dip ?—Yes, we get a great assistance from it. The dip of the seam is 1 in 3¼. Consequently, when the fan is stopped we get a very fair ventilation from the heat of the seam.

18652. Have you had any experience in dust explosions ?—I have never had any experience in any explosion.

18653. You are very lucky ?—I am: but I do not boast, for fear misfortune should happen to me.

18654. You think that the watering of the dust in zones might prevent the spread of an explosion ?—I could not say that from experience, because I have had no experience in regard to explosions. I am rather looking to the result of this Commission to tell us what length of zones should be safe. I may say that I have had a great number of analyses of dust made recently from our working in order to find out whether it was really true that the dust which lodged in the crevices in a main haulage road, for instance, was so very much more dangerous than other dust lying on the road; and I think from the results I have found that it is so, and that the dust in the crevices is the only dangerous dust. I have also had analysed all the dust from the roof and sides in some of our other roads besides the main haulage road, and with regard to a great deal of that dust it appears to me to be very doubtful whether it would be dangerous. I find it shows in many cases as much as 67 per cent. of shale dust—67 per cent. of ash—and it seems to me that it is a question for this Commission to decide by experiments what would be the result of dust like that becoming ignited, if it will explode.

18655. What is the nature of the "other" roads, as you call them ?—Horse roads. Of course, haulage roads I take to mean simply those roads where mechanical power is used; I think that is the definition which has been applied to them. Of course, we have other roads where there is horse-power used, and where also manual labour is used.

18656. Horse-power would cut up the floor, and the dust would be converted from shale ?—It does so. That is the reason why in horse roads we do water a little, in order to prevent the floor getting too much punched up. We do not water in any of the engine roads, except it be by accident when the water swills out from the "water wagons" or "water carts" used for bringing water along the roads. We do not sprinkle out water purposely in these cases.

18657. But you say the dust in the horse roads is not nearly so explosive as the main haulage road dust ?—I say I think that the dust which lies on the floor is not so explosive as the dust which lies in the crevices in the roof and sides. But I say that the dust, even on the roof and sides, seems to have such a large percentage of shale dust in it th t I think there should be further experiments made to see whether that dust is explosive. It seems to me that a dust containing 58 per cent. or 60 per cent. of shale dust, leaving only about 40 per cent. of it coal dust, cannot be very explosive.

18658. What was the quantity in the main engine haulage roads ?—In the engine haulage road, in the main down brow, the least quantity was 45 per cent. on the floor and 17 per cent. on the roof and sides. That I should expect would be an explosive dust—if there is only 17 per cent. of ash in it. But then when you come to these others on the haulage level, with 67 per cent. of shale dust in dust taken from the roof and sides, I should think it is a question whether that would be explosive dust.

18659. (*Chairman.*) You have not tested these dusts yourself ?—I have no means of testing the explosive characters of them. The only thing we can do is to analyse them, and I have had a large number of them analysed.

18660. (*Sir Lindsay Wood.*) You say you do not get much dust from the screens going down the shaft. Are your shafts wet ?—No.

18661. Then is there no dust going down ?—I think very little; we cannot find any dust about the bottom of the

Digitized by Google

shaft; there is a little dust blown off the wagons as they are going up the shaft, but there is no dust that we know of going from the screens. Our screens are not so near to the pit shaft.

18662. Are they a good distance from it?—20 or 30 yards, perhaps.

18663. (*Mr. Ratcliffe Ellis.*) With regard to your table of analyses of the dust, is it in a condition in which you can hand it in, or would you prefer to complete it first?—It is scarcely in a condition in which I can hand it in, but I shall be very pleased to send a copy of it to the Commission.

18664. Have you estimated the cost of watering?—I have tried some experiments, more with a view to seeing what the cost of watering a zone would be than anything else.

18665. Can you give us some information with regard to that?—I have been trying the effect of watering with calcium chloride solution in a zone, and I find it costs about 9*s.* 2½*d.* per 100 yards for effective watering of the floor, roof and sides, and about a half of that amount for watering the floor alone.

18666. (*Dr. Haldane.*) 9*s.* 2½*d.* for one watering—each time?—Yes, each time.

18667. (*Mr. Ratcliffe Ellis.*) How long do you estimate that would last?—It is very difficult to say with calcium chloride. Brunner Monds are the producers of it, and they recommend for surface roads that it should be used twice at short intervals, say of a day or a couple of days, and that afterwards it would last for a considerable time. But it is impossible to say how long it would last in mines. They estimate that on the surface it would do to use it about four times a year, but I do not think that would do in a mine at all; I think it would have to be much more frequent than that. We watered on the Thursday, and then we watered a second time on the Friday, and then the pits were stopped on the Saturday and Sunday, and we left it to stand until the Monday, and on the Monday there was no trace of wet; there was a dampness in the dust—the dust was quite damp.

18668. (*Dr. Haldane.*) What strength of solution do you use?—They recommend 5 cwt. to 500 gallons—1 cwt. to 100 gallons; it is a very strong solution. It is so strong a solution that it crusts where it is left to drop and is not disturbed.

18669. (*Mr. Ratcliffe Ellis.*) But that would be a serious expense?—That would cost about £8 per mile, and in our collieries we have nearly 22 miles of mechanical haulage.

18670. What is the total distance of haulage roads that you have?—We have about 61 miles of roads altogether.

18671. How many shafts have you at your colliery?—10 shafts.

18672. Then would you consider it necessary to water all those roads?—No; that includes the air roads.

18673. What is the distance of roads that you would consider it necessary to water?—It has been suggested that only those roads which are used for mechanical haulage should be watered. In that case there would be about 22 miles of them.

18674. Then if you had to water them pretty frequently it would come to a good deal of money?—It would come to about £176 for each watering, and if that had to be done twice a week it would become a very serious matter.

18675. Now with reference to the regulations for shot-firing: do you think it is desirable that there should be an interval prescribed before a shot which has not gone off should be inspected?—Under the old system it was very desirable, but under the new system with shots fired by electricity I do not think it is necessary that there should be a very long interval.

18676. But do you think it should be prescribed?—I do not see any harm in prescribing it.

18677. There should be an interval, of course?—Yes, there should be some interval. I think in the case of electrical firing either the shot will go off or it will not; I do not think it requires a very long time; there is no hanging fire with electrical firing.

18678. It is said that there have been some cases, no doubt very exceptional, where there has been some hanging of fire?—I have not met with such cases myself.

18679. Do you think there should be any regulations prohibiting more than one shot being fired at a time?—In a haulage road?

18680. In a haulage road?—I think it would be desirable.

18681. At the present time according to the regulations, unless the road is damp, there must be watering for 20 yards near the place?—Yes.

18682. Do you think that distance should be extended?—No, I do not think there is any necessity to extend it beyond that distance.

18683. Do you think the rules as to shot-firing as they appear in the Mines Regulation Act and in the Explosives Orders, might be codified with advantage?—I do. I am making an attempt myself now to codify them for the use of our own workmen.

18684. And you think that very useful?—I think it would be very useful. I might say with respect to shot-firing that circumstances at different collieries vary very much; in one of our largest collieries we have not had a shot fired in a haulage road for the last 12 years—not one shot; and in other haulage roads it is a very rare occurrence for a shot to be fired with us.

18685. Then I suppose the danger is from a blown-out shot?—Yes.

18686. Do you think the rules are sufficiently in detail with reference to the preparation for the shot—the drilling of a hole, and so on?—I think it would be very difficult to make very detailed or very definite rules in that respect. I think much must be left to the judgment of those using them. The instructions that we give to our shot-lighters are that unless the hole is in their opinion satisfactorily placed, and everything is satisfactory, they are not to charge or to fire the hole; the shot-lighter has that discretion.

18687. That is a rule which you make because you think it is necessary for safety?—Entirely so.

18688. There is no such rule in the Coal Mines Regulation Act?—No.

18689. Do you think it might be desirable to make such a rule as that?—Well, seeing that I have adopted these rules myself for the safety of our collieries, I can scarcely answer otherwise than yes.

18690. Have you any special method of instructing your shot-lighters?—Only by the managers getting them into their office and giving them instructions, which they frequently do.

18691. Is that done with the old shot-lighters as well as the new hands?—Yes.

18692. With everybody?—Yes.

18693. I suppose they are authorised in writing to do the shot-firing?—Every shot-lighter is appointed by a written document, of which a copy is kept by the manager, authorising him to fire shots in certain districts, and limiting the district in which he has to fire the shots.

18694. Do you think that if the shot-firing rules were codified it would be desirable to have the rules relating to the shot-firer's duties printed on his authorisation?—Well, I see no harm in it.

18695. In order to bring the matter more to his attention?—It would be rather a lengthy document to print on his authorisation, I think.

18696. As the rules are now it would be very lengthy?—Yes.

18697. But if they were put into a much shorter form do you think it would be well to do that?—I think the better plan would be to codify them, and perhaps print them in a small pamphlet and let him have that.

18698. Not to confuse him with the whole of the rules, but only to give him those which were necessary for his employment?—Yes, that would be very desirable. It has been suggested that all those shot-firers should pass some examination for competency.

18699. What do you say with regard to that?—For my own part I scarcely think it is necessary; I think it should be left to the manager to satisfy himself that the man he appoints is a thoroughly competent man; I think he can subject him to a sufficient examination to see whether he is competent or not.

18700. And the manager is responsible, of course, if he does not provide a competent man?—The manager is responsible in all cases.

18701. It has been suggested that it is undesirable to let one man fire his shot, and that there should be two men engaged, one in charge of the explosive and the other in charge of the detonator. I think that was the suggestion?—I do not think there is any necessity for that. I

Digitized by Google

Mr. Henry Bramall.

1 May, 1907.

prefer to make one man responsible for everything of that kind—for the detonator and for the apparatus for firing; but of course he is never alone, because if it is a shot fired in the coal face the collier who has prepared the hole is there with him until the moment for firing the shot.

18702. Do you think it desirable that there should be experiments made upon these various questions as to the dangerous character of the different kinds of dust, and as to the extent that it would be necessary to clear a road from dust, or to water a road, in order to secure safety?—I do.

18703. That is desirable in the interests of safety generally?—I think it would be very desirable, if it could be done, that there should be some permanent method by which dust could be examined—not merely, we will say, for the purposes of this Commission, to be afterwards printed and have an end of it, but supposing you had dust in certain roads in a mine, and you wanted to find out whether the dust was explosive or whether it was dangerous, that there should be some place where you could get that information and have the dust tested; besides, there might be a dispute arise between an inspector and the manager of a colliery, and the inspector might say "I consider this dust explosive and dangerous" and the manager of the colliery might say "I think it is so charged with inert mineral matter that I do not think it is dangerous," and then who is to decide the question between them?

18704. I believe you have had cases of that sort where, on looking at the dust it was thought to be very dangerous, but when you came to examine it it was found not dangerous?—I had a case when Mr. Hall was making his experiments upon dust firing; I sent him a sample of dust from the firiest mine we have, gathered from the roads, and he was unable to explode it. Then he wrote to me about it, and I said "I can find you a dust that will explode," and I sent him another sample swept from the screens and gathered carefully—pure coal dust; that, I think, gave one of the most violent explosions that he had in the whole of his experiments.

18705. That was from the same seam?—That was from the same seam, but not the same dust. It showed that the coal dust from that seam in itself was an extremely violent explosive, but that as it occurred in the mine, mixed with shale and dirt from the roads, it was deadened to such an extent that it would not explode.

18706. Then do you think that was the case with the dust, not merely on the roads, but such of the dust as might be about the bars, and the roof and sides of the mine down below?—That is the question which I have been trying to examine into in getting these analyses made. I find that a great deal of this dust which I myself thought would be very dangerous dust, being lodged on the timbers and in the crevices on the sides of the road, on analysis gave such a large percentage of inert matter that I am a little bit puzzled now—I do not know whether it is explosive dust or not, and I have no means of testing it for explosiveness. We can test it by analysis, but I have no apparatus and I do not know whether there is any apparatus by which I can have it tested in order to see whether the dust is explosive.

18707. (*Dr. Haldane.*) I think you should send some of that dust to Woolwich for these experiments to be made?—Yes.

18708. (*Mr. Ratcliffe Ellis.*) It would be very desirable to do so?—I shall be very pleased to do anything of that kind.

18709. (*Dr. Haldane.*) These are very interesting analyses, and they will give us a lot of valuable information if you could send some of the dust to go with these analyses?—Yes.

18710. (*Mr. Ratcliffe Ellis.*) Do you think there could be an explosion of dust without any gas at all?—I think there can be; in fact I have seen explosions of dust without any gas, but not under the conditions which exist in a mine. For instance, we had some screens where we screened the Trencher Bone coal—that is the mine where the great explosion was, and it is the same as the Wigan 6 ft., the most dangerous mine in Lancashire; on one or two occasions on those screens the gas-lights fired the dust in the screen; in fact I took the gas-lights out and put in electric lights for that reason, because I was afraid the screens would some day take fire. That was a case where there was no gas that I know of; I do not think there could be any gas, but I think it was simple dust. There must have been some peculiar physical conditions at the time, because it did not fire every day. The same process was going on every day, but the dust did not fire every day; it was only on one or two occasions that it fired.

18711. (*Mr. F. L. Davis*) Were the gas flames big?—Not very large—the ordinary 5-feet gas burners.

18712. (*Dr. Haldane.*) I suppose your suggestion is that it was on dry days, or something of that kind, that it fired?—I am at a loss to make a suggestion. I think it was, if anything, not the dry days or damp days but the amount of dust that was present in the atmosphere that made the difference. If it was too saturated with dust perhaps it would not fire; perhaps if there was not enough of it it would not fire; but I can only think that it must be that at certain times the amount of dust contained in the atmosphere was the right amount for making it explosive. I tried another experiment also with the same dust, at the time when we first adopted permitted explosives; I tried the effect of firing a shot in the midst of dust with gunpowder, and also with a permitted explosive, and I was able to make an enormous explosion with the gunpowder shot, out of a wheel-barrow full of very fine coal dust from the Trencher Bone mine.

18713. (*Mr. Ratcliffe Ellis.*) But not with the explosive?—I could not fire the dust with the permitted explosive at all.

18714. The German system is universal watering, with certain exceptions. Would you approve of that in this country?—I do not think that I should.

18715. Do you think it desirable that, so far as practicable, accumulations of dust should be prevented?—I do. I think a regulation to that effect might be made.

18716. And of course that if they did accumulate they should be removed?—If they were prevented they would not accumulate.

18717. They would not, that is true. You would leave it to the manager to say in what way he should carry that out?—I would leave it to the management, subject, of course, to the mines inspectors.

18718. Do you think it desirable that protected zones should be made compulsory, either by watering or by cleaning them from dust, leaving it to the management as to whether they would water or cleanse them from dust?—I think there is a little difficulty about that being made compulsory. Where would the zones be placed, or who would settle where the zones should be placed?

18719. The object of the zones would be that in case there was an explosion the zone would stop it and would prevent it from extending as it otherwise would do but for these protected zones, and the situation of them would have to be fixed with relation to that object?—It would have to be left with the management?

18720. Quite so.—Then that might not satisfy the inspectors.

18721. The inspector would have his remedy, I suppose, namely, to arbitrate if he thought that it was not being done properly, with regard to the manager's method of carrying out the law?—It is a very cumbersome and expensive process to have to arbitrate upon those matters.

18722. But do you think that the usefulness of such zones would be so great as to necessitate legislation requiring them to be adopted?—I am not very sure that they would. I would rather much more rely upon trying to prevent the dust by the method which I have adopted in my practice. I have tried to accomplish that by using close-bodied wagons with as little chance as possible to allow any dust to escape from them; and then I think the rules should be made very strict indeed as to shot-firing. I do not think the rules as to shot-firing can be made too stringent, especially in roads—apart from the faces. I do not consider that there is the same danger in the faces, but so far as the roads are concerned I do not think that the rules as to shot-firing can be made too stringent.

18723. You think that if the cause is removed as far as possible that would secure safety quite as well as preventing the extension of the explosion if there is an explosion?—That is my opinion.

18723a. (*Mr. W. Abraham.*) I think you said you never had experience of an explosion; at your place?—No, I have never had an explosion.

18724. Have you had any experience of explosions at other places?—No, I have not had anything to do with explosions.

18725.—Evidently there is one of your collieries which is, we may say, very gaseous, is there not?—All our collieries would be more or less gaseous if the ventilation was not well kept up. I do not know whether you are alluding now to the one where the great explosion took place, the Clifton Hall Colliery.

Digitized by Google

18726. My mind is rather upon the colliery, whichever it is, in which you said you had an explosion of dust under certain conditions at the screens ?—Yes, that is the Clifton Hall Colliery—the Trencher-Bone mine.

18727. Then that explosion took place in the open air ?—Yes—it was practically in the open air. The top of the screens was boxed in, and the coal was poured in at the top of the screens, and the screens were closed in, and there was a current of air which to a slight extent passed through the box and out at the top, and it was at the top where it exploded.

18728. With a screen closed in, it would not be as confined as in some parts of the colliery where a tram of coal or journey of coal would have passed before it came to the surface ?—Oh, yes—more so. In any part of the colliery where a tram or a journey of trams would pass through, the coal would be in the trams, and there would be only a surface of the coal exposed. In this case the top of the screen—the point where the explosion took place—was where the coal was tipped over into the top of a boxed-in screen, so that all the dust in the box would be raised up in a cloud as it fell upon the bars of the screen, and the current of air passing through this boxed portion would collect the dust with it and carry it out through the top end of the screen. There is nothing of that kind possible in a colliery—within the mine.

18729. But would there be more coal than is contained in one tram in that box at the same time ?—No.

18730. Then with a journey of trams coming out through a narrow place, is it not possible that a certain amount—the necessary amount—of dust arising from the shaking of that journey would cause an explosion there if it did come into contact with naked lights ?—I do not think it is at all possible, because the cloud of dust coming from a journey travelling in a contracted road in that way is not very great. The air is not impregnated very much with it; but a cloud of dust coming from the tipping up of a box containing a large quantity of dust in a narrow confined space, perhaps 4 feet by 3 feet, and being met by a current of air, is an entirely different thing; you could not compare the two.

18731. I think you are of opinion that spraying water on the surface of the coal in the course of transit from the face to the pit would, by some means or other, reduce the sale value of it ?—Yes.

18732. What distance have you to send your coal to your markets ?—Varying distances. We sell a great deal at the pit mouth, and we send it to distances up to 30 miles, perhaps; that would be the extreme.

18733. Say 20 miles, then, or 12 ?—It would not average more than 12 miles.

18734. Twelve miles is a good distance. Have you experienced any of that kind of difficulty—that the price of the coal which you have sold has been reduced because it has been transmitted on a very wet day, more than on a dry day ?—No.

18735. You have had no practical experience of what you fear would happen ?—Yes, I have tried to experiment by damping the coal in that way, and I have found that we could not handle it on the pit bank; we could not make it marketable. Perhaps I might mention a little difference which exists between the South Wales coal and our coal. When you speak of coal in South Wales you speak to a great extent of round, lumpy coal which might be damped without very much injury; but when we are speaking of coal in our district we are speaking about a mixture of coal and slack, much of which is very small—perhaps 30 per cent. to 40 per cent, of it would go through a seven-eighths bar—and that is a mixture all together in the pit boxes. When you come to spray a mixture like that and spray it on the top with a scattering of water—as I have said before, it takes 5 gallons of water to damp it half an inch deep—that little crust half an inch deep, when the box begins to jog along the road, breaks up directly, and you get the coal dry as before, so that the spraying to that extent is useless. But if you spray it to such an extent as to damp the coal thoroughly and prevent the dust being blown off, then it takes about a gallon and a half of water to every cwt. of coal, and the result is that when it gets on to the bank you have a mass of damp slack and coal and nuts all mixed together, and you put it into your screen, and you cannot separate the slack from it, and you cannot separate the dust out of it, and you cannot make nuts—you can do nothing with it.

18736. Have you had that experience of wetting the surface of your tram in the transit of coal from the face to the shaft—that you have ever wetted the surface of the tram to the extent of half an inch ?—Yes, we have tried that. That is quite useless to prevent dust arising.

18737. It would prevent dust arising in the transit, would it not ?—No, because the thin crust gets broken up directly.

18738. Well it gets broken up on the surface of the tram in the transit ?—Yes.

18739. Then it is broken up before it comes to the screen ?—No, that is only just a light scattering, which I say is useless. I say that if you carry the spraying to such an extent as to keep down the dust and make the coal so damp that it will give off no dust, then you make it so damp that you cannot handle it on the surface for the purpose of screening.

18740. We will take the experiment of the half-an-inch: surely where you damp the surface of your tram to the extent of half an inch no dust would emanate from that tram ?—Oh, yes; as soon as it gets on the road that half inch of crust is broken up and the dry dust comes to the top again.

18741. Are you speaking now of spraying the trams before they start ?—Yes.

18742. And not spraying them on the way ?—No, I was speaking of spraying them before they start.

18743. Have you ever had any experience of spraying them on the way ?—No.

18744. Have you done it to see what effect it would have ?—We have not done that.

18745. Generally speaking, what is the nature of the strata in the mines under your supervision and under your management ?—Do you mean the roof and floor ?

18746. Yes ?—The floor is generally what we call "warrant," a kind of bastard fireclay. The roofs vary from what we call metal, which is shale——

18747. Is that blue shale ?—Blue shale, and in many cases what in our neighbourhood is called "lin and wool"; that is a sort of sandy shale—bands.

18748. Hard sand or wet sand ?—No, it is a mixture: you cannot distinguish the sand from the shale, but it is more in the nature of a rock than a shale.

18749. So that as a rule you have a good top from that kind of shale ?—Where we get a good bind roof we have a fairly good roof; but most of our roofs are not good; most of our roofs are weak.

18750. That is what I wanted to know; so that most of your roofs are not of that character of shale combined with sand ?—No.

18751. Therefore, I was asking the question as to what is the character, generally speaking. You said that the bottom is a kind of mixture of fireclay ?—Yes.

18752. Which would be effectively watered ?—Yes.

18753. Then I should like to know what is the general character of the roof ?—You might take it that the character of the roof is a shale, speaking generally. It varies, of course, a great deal; in one mine in some places we have a rock roof.

18754. Have you experienced from artificial watering any danger to either bottom, top or sides ?—Yes.

18755. Will you tell us the effect of your experience ?—We have tried it, and we found that if we water the sides pretty freely it causes that shale to disintegrate and crumble away, and takes away the support from the roof. I may say that all our roads are "packed" roads. The support of the roof depends upon the packed sides—the buildings on the sides—which are made of shale.

18756. The surface of the shale which you happen to wet at the time gives way, and the wall becomes smooth at the side—the surface ?—Oh, dear, no. The walls crumble down and let the roof down.

18757. Have you any experience of that kind ?—Yes. We have had one of our pits stopped last week for a day and a half in consequence of the giving way of the main engine plane.

18758. From the effect of artificial watering ?—No, not from watering—from it getting wet. Of course, if you put the water on artificially you get exactly the same result.

18759. But it must be a very extraordinary amount of artificial watering that would do that, must it not ?—No, I do not think so, because if you take a lump of that same shale and expose it to the ordinary atmosphere without any rain, the moisture of the atmosphere will cause the shale to crumble and decay.

18760. The blue shale ?—Yes.

Digitized by Google

Mr. Henry Bramall.

1 May, 1907.

18761. Does not that indicate that it is very soft shale?—Well, it is a soft shale in one sense.

18762. Extraordinarily soft, is it not?—No, I do not know that it is extraordinarily soft for shale; shale is not a very strong material.

18763. But it makes a good top sometimes when you get it, does it not?—Sometimes it does, sometimes not. It is a fairly good top so long as you can keep it dry; but if it gets any moisture in it, then it is not a good top.

18764. Yes, I agree—from natural watering. I understand you have had a lengthy experience, and I should like to know from your experience what amount of artificial watering on the surface of that shale would be necessary to bring about the same results as a natural watering in the shale—because it all depends upon the danger that is supposed to arise from this watering?—I think by the continued watering of the sides—shale built up, on the sides—the water would be absorbed into the shale and the shale would split up into fragments and lose its cohesion, and the walls would crumble down and let the roof in.

18765. "Continued watering"—you qualify it in that way?—Well, unless the watering was continuous it would be of no use; it would be of no use to water the road and then to leave off the watering for any length of time.

18766. But would it not answer your purpose, in order to prevent the dust flying about, to water it when the journey of trams passes through your roads?—To water it each journey?

18767. Yes?—That would mean watering it 100 times a day, perhaps; it might in some roads be 100 times a day.

18768. Well, that would not be continuous?—I call it continuous if you have to water them once or twice a week.

18769. Then it is possible for us to differ as to what is meant by "continuous"?—I mean it would be useless to water the road once, and to think that that would have any permanent effect upon it. The watering must be repeated at short intervals continuously, and the road must always be kept in a state of dampness if it is to be efficient; that is my opinion.

18770. You are speaking now of the roads. Have you in your long experience known any artificial watering of the dust that would affect the workmen in the working faces?—No; I should stop it before it got to that extent.

18771. Yes, very likely. So that, after all, when you are speaking of that humid state of the ventilation, that is not in the practical working?—Well, it is in the practical working, and in this way: some time ago we had a slight outbreak of water nearly at the greatest depth that we are working, and it became necessary to deal with that water; we had no pumps, and we could not fix any pumps there, and the only method of dealing with it was by bringing it out in watercarts. That, as you know, causes a great deal of splash and mess all about, the result of which was that the air current in that portion of it that passed that wet place where we were dealing with the water was carried further into the road on to the other men who were working, and they had to knock off.

18772. Working on the road?—No, working at the face. That was a sufficient proof to me; it was only one small example, but you have only to increase it to the roads in the pit and you have the same effect throughout the pit. It was a sufficient sample to show me what the effect would be.

18773. You were carrying the water out from a natural outburst of water somewhere inside?—Yes.

18774. And beyond that there came the effect upon the men?—Exactly.

18775. So that there you had the effect of the natural water bursting out and losing it on the roads?—No, you mistake me; there was a little outburst of water which was collected in a water hole on the lower side of the level, and then, to get rid of it, it was filled from there into watercarts and drawn out, and, as you know, the effect of filling water with buckets into watercarts and dragging the watercarts about is to splash and mess the water about a great deal, sufficiently so to make the air passing that particular wet point—moist—and that air after passing that place and being carried into a working face affected the men at that working face. The effect was very similar to that of an extensive watering, only in this place it was confined to one small corner of the mine.

18776. That was your experience as to what happened in a small corner of the mine, beyond where the outburst of water was, and beyond where the splashing of water was?—Yes.

18777. And that is the one experience which you have had in your lifetime?—Well, it is the one experience of that mine.

18778. You, upon that, base the opinion that watering of roads would affect the health of the workmen, or the ability of the workmen to work?—I do.

18779. (*Mr. F. L. Davis.*) Why did you try this solution of calcium chloride instead of watering?—My attention was directed to it on account of the great agitation there is now as to dustless roads in connection with motoring. This solution has been brought out as a cure for dusty roads for motoring, and I thought if it was such a very effective preparation for that purpose it ought to be equally effective in laying dust in collieries; therefore I was desirous of trying it.

18780. Your objection to watering being because of the effect that we have already heard of upon the men working in the high temperature, you wanted to see whether you could lay the dust with this solution, which would not have the same effect—it would not require doing so often?—No, it would not be necessary to saturate the air of the road. If you could get a solution like that which would lay the dust and lay it for three months or six months, or whatever it might be, and besides that would attract moisture from the atmosphere to some extent, I thought it might be a useful thing in some cases. I do not propose to do that where we have these very high temperatures, but, of course, in a colliery so extensive as ours there are places where we could use it with advantage, where we are not working in this very high temperature.

18781. But taking your mines generally, you say that from the high temperature and from your knowledge of it you could not do with regular and thorough watering?—We could not do with watering to such an extent as to saturate the atmosphere—on that ground.

18782. You have had no experience in your own mines of ankylostomiasis, I suppose?—No.

18783. I have no doubt you know something about it, although you have not had any personal experience of it?—I have no personal experience of it, and I know nothing about it except what I have read.

18784. From what we read, in a mine with a high temperature like that, saturated with damp atmosphere, ankylostomiasis would be very likely to thrive?—I believe those are the conditions under which it does thrive—heat and damp.

18785. (*Mr. Smillie.*) Does that solution of calcium chloride extract moisture from the air, or does it give off moisture?—It extracts it from the atmosphere; it is a deliquescent salt.

18786. So that watering with a solution of calcium chloride would not give rise to the evils which you fear, of charging the atmosphere with dampness?—No.

18787. It would be rather the other way?—It would be rather the other way.

18788. It could not make a very dry atmosphere much drier, but it would not charge it with dampness?—No.

18789. So that so far as your objections to watering are concerned, watering with a solution of calcium chloride would not have the effect that you fear?—You say so far as my objections to watering are concerned; I think you ought to say "so far as its effect on the workmen is concerned."

18790. I beg your pardon—as far as the effect on the workmen is concerned I take it, it would have the same effect on the roof and sides as ordinary watering?—Exactly; the danger to roads and the danger from falls would be just the same.

18791. But it would not have the effect which would be injurious in making the atmosphere moist, which you fear, that ordinary watering would?—No. I was in hopes, from what I have read and from what I know of calcium chloride, that it might have the effect of keeping the dust in a damp state without saturating the atmosphere with moisture.

18792. In the figures which you gave for your 21 miles of roads, which you said would entail a great deal of expense to water, you were dealing with the whole of your mechanical haulage roads?—Yes.

18793. I think you said 21 miles out of 61 miles of roads altogether?—21 miles out of 61 miles altogether; it is 22 miles, practically.

Digitized by Google

18794. Supposing scientific experiments which might be carried out proved that a 100 yards zone thoroughly watered would prevent the continuance or spread of an explosion, then it would not be so costly to water zones by a calcium chloride solution as it would be to water the whole of your haulage system ?—No.

18795. Supposing 50 zones of 100 yards each required to be made into 21 miles of haulage, it would not be by any means so costly as watering the whole of your 21 miles ?—No.

18796. Did you say the cost was 9*s.* per 100 yards ?—Yes.

18797. Was that for watering with a solution of calcium chloride ?—Yes.

18798. For 100 zones that would not be so costly, in such a large colliery as yours with such an immense output ?—It would depend to some extent upon where the zones were situate. This 100 yards that I speak of, being only an experiment, was as near as we could get in the roads to the pit. If you come to deal with 100 yards zone requiring watering and attention, and that zone is some 2,500 or 2,600 yards away, or even more than that—I think the longest distance from our pit shaft to the furthest working is 3,500 yards—but supposing it was even 2,500 yards away from the pit shaft, then the cost of watering that zone would be very much larger than the cost of watering 100 yards near the pit.

18799. The additional cost being the carriage of the water ?—The carriage and the time taken by the men in taking the water there.

18800. Of course it would not cost any more with regard to time occupied to water 100 yards, 2,000 yards from the pit bottom when you had the water there ?—No, when you had the men there and the water.

18801. It does not seem to be a very expensive method. Are we to understand that you thoroughly saturated it in the experimental 100 yards ?—Yes, that was thoroughly saturated.

18802. I suppose this solution of calcium chloride would have the same effect as ordinary watering, of course, so far as the roof and sides were concerned ?—Yes.

18803. Generally in your mine you could not risk that, because of the nature of the roof and sides in some parts of it ?—Yes.

18804. (*Mr. Ratcliffe Ellis.*) I understand that is each watering ?—Yes, on each watering.

18805. (*Mr. Smillie.*) But I understand you to say that you expect that after the second or third watering you might have such a surface that you would not require to water again for a considerable time. That was your hope—that you might form such a surface with this solution of calcium chloride ?—Yes. The manufacturers say that after the first two or three waterings, waterings at long intervals would be sufficient. Of course I only know what they say, and I am going to try it and see.

18806. That would be for ordinary roads on the surface, where there was not a continuous deposit of coal dust ?—Yes, and where no doubt the roads would be exposed to the weather and would get wet occasionally.

18807. But supposing you had a surface made perfect by two or three waterings with this solution, you would still have the dust being deposited from the trams in passing and the haulage in passing ?—Yes.

18808. Which might be dangerous ?—I anticipate that there would be more accummulated dust, because you will always find that if there is a little damp or moisture in the road the dust will collect there, and you will find it in pretty large deposits there, but it might be in a damp condition.

18809. I suppose we may take it that all your haulage roads from the working face right to the pit bottom are pretty steep in inclination ?—No, not all of them; some of the roads are on the level, of course.

18810. Have you an incline of 1 in 3½ ?—Those roads which run from crop to deep direct are about 1 in 3½; but then we have a good deal of haulage on the level as well, off the brows.

18811. Yes, but where you are going direct the inclination is 1 in 3½ ?—Yes, that is about the dip of the mine.

18812. That is pretty steep. So far as I can see from the fact that your pits are only 500 yards deep, but that you are working the coal at 1,200 yards almost, you must be a considerable distance from the pit bottom ?—Yes.

18813. 3,000 yards, I think you said ?—That is including the levels. The furthest working face from the pit at that particular pit is, I think, 3,500 yards.

18814. Can you tell us how the men load in their tubs here; do they load them full up to the mouth of the tub ?—Yes, they heap them up.

18815. With the tubs coming up an inclination of that kind, there is bound to be a considerable amount of dust shaken off the top of the hutches ?—No, not very much. The brow is remarkably clean.

18816. Is that because your coal is fairly round ?—No.

18817. With the tubs coming up an inclination of 1 in 3½, if the small coal is on the top there is bound to be a considerable amount of it shaken off ?—No.

18818. If the hutch is full up to the top ?—No, there is not much shaken off. Of course you must remember also that if a tub is filled fairly well at the face, before it travels very far along the road it settles down a good deal.

18819. Quite so. What is your system of haulage; is it single tram haulage, or trains of trams ?—We use what you may call a single road endless rope haulage; it is endless rope haulage with a single road.

18820. And a train ?—Yes, we run a train.

18821. Do you ever have any upset of the whole train on your haulage road ?—Occasionally we get upsets in the brows, but not very often; we very rarely get an upset on the level.

18822. Have you ever a breakage of the haulage rope on which the whole train gives way ?—We now and again get a breakage of the haulage ropes in the levels, but it is an exceedingly rare thing in brows. The reason of that is that we wind men on the brows, so that we have to be as careful with our haulage ropes on the brows as with our winding ropes in the shafts.

18823. And you have to use stronger ropes ?—Yes, and we watch them.

18824. But in any case where there was an upset of a whole train of trams it would give rise, as Mr. Abraham has pointed out, to more dust than you had on the surface where you had an explosion ?—I do not know that it would give rise to more dust than that, because the current of air going down the brow is so strong that it would dilute it and carry it away and disperse it more rapidly.

18825. In the case of your explosion on the surface you had only one tram tippled at a time ?—Yes.

18826. You might have a dozen trams tippled over by a wreckage in the pit ?—It is very rarely that a rope breaks, but sometimes we have a broken coupling between the wagons, and a wagon or two may break loose and run down; they sometimes run a very considerable distance down the brow before they run off the road or anything happens to them. Generally what takes place is that the wagons get off the road, and they do not upset in the way you are speaking of; they get off the road and then they stop.

18827. Even on that steep incline ?—Yes, even on that steep incline.

18828. Did I understand you to say that it took 9 gallons of water to saturate the top of a tram ?—No.

18829. To saturate the whole tram ?—It took 12 gallons of water to saturate a tram containing 8 cwt. of coal; that saturated it and made the whole of it wet.

18830. Would one gallon of water be sufficient to spray the top of a tram so as to make it impossible for dust to go off the top of the tram ?—No, and five gallons would not be sufficient.

18831. 12 gallons saturates 8 cwt. of coal ?—Yes; but I ought to tell you that we did not sprinkle 12 gallons of water on; in order to saturate it we made a hole in the centre of the tub and poured the 12 gallons of water on and let it saturate down into the whole of the tub.

18832. But have you ever tried the effect of simply sprinkling the top of a tub ?—Yes, we sprinkled five gallons on the top of a tub.

18833. And it was not effective ?—No, it would not penetrate into the dust, but it would only just go on the top of the dust and then run off.

18834. (*Mr. Wm. Abraham.*) The solution would not penetrate in the same manner as clear water would ?—This was not solution; it was done with clear water.

18835. (*Mr. Smillie.*) You said in answer to Mr. Ratcliffe Ellis, I think, that you were not in favour of shotfirers holding a certificate of competency; that you had

Digitized by Google

Mr. Henry Bramall.

1 May, 1907.

heard the suggestion made, but that you, personally, were not favourable to it. I think your reasons for that were that the manager was responsible for the shot-firer's competency?—Yes.

18836. When does that responsibility arise; is it when a shot-firer is killed by an explosion that the manager's responsibility arises?—The manager is responsible for everything that the shot-lighter does.

18837. But who knows anything at all about whether the shot-firer is competent until a mistake takes place and he is killed?—I should think the manager would not appoint a man that he did not know something about, or a man who had not had some experience.

18838. Do you think a mine owner would appoint a manager that he did not know anything about, and that he had not some experience of?—I do not think he would; I do not think even if he had a pocketful of certificates he would appoint him unless he knew something about him.

18839. But you are aware that he could not appoint a person as a mine manager now to take charge of a mine who had not a certificate?—Yes.

18840. You say you do not think a manager would appoint a person to be a shot-firer who in his opinion was not competent?—I should not think so.

18841. But where does his responsibility come in?—Do you mean the manager's responsibility?

18842. To whom is he responsible?—He is responsible to the Government, is he not?

18843. I do not know where the responsibility comes in, but I want to know?—I think the manager is held responsible for every man in the pit.

18844. Do you know whether any enquiry is made by the Government, or on behalf of the Government, as to whether a shot-firer is a competent person?—I think there would be if an accident took place.

18845. But in an accident is not the shot-firer usually killed by the accident from his firing the shot?—I have not had any experience of that.

18846. Have you ever heard of a shot-firer escaping on an explosion taking place as the result of his having fired a shot?—No, I cannot say that I have.

18847. I think no one else has?—I cannot remember that we have ever had any explosion from shot-firing in our particular collieries.

18848. Do you know of any accidents, either in your own experience or those which you have read about, arising from shot-firing?—I have read of them.

18849. In which competent persons had been appointed to fire shots?—Yes, I suppose they were thought to be competent, but what I was pointing out was that the question of the shot-firer having a certificate or no certificate does not make much difference, in my opinion, because the manager himself would enquire very carefully as to the competency of the man, and be very cautious what sort of man he appointed to be shot-firer, and would satisfy himself that he was a competent man—not only a man who might get a certificate, but a competent man in other ways, and that he was reliable and a trustworthy man.

18850. I think you might put it that you would, and that any other manager should do so, but you certainly do not know whether all managers would?—Yes.

18851. I think your mines where you are working the coal are the deepest in Great Britain?—I think so.

18852. And probably the hottest?—Yes, I should think so.

18853. You have lately, I think, considerably extended your mechanical haulage?—We are continually extending it; as the workings get further out we are continually extending the haulage.

18854. Did you find some time ago that it was so hot and that the temperature was so high that the horses could not live in it?—No, we never found that.

18855. Did not Mr. Knowles state at the last meeting of the shareholders of your company that you had had to put in mechanical haulage because you had lost nearly 20 horses in a month?—I never heard him say so. I was present at the meeting, and I did not hear him say that.

18856. We understand that the statement was made that the temperature was so high that horses could not work in it. Have you heard a statement of that kind?—No, I have not heard that.

18857. Do you know from your own experience whether men and boys can work in a temperature which horses could not stand?—I think they can.

18858. Has it been your experience of Knowles Colliery that that is so?—It has been my experience that they can.

18859. Then it is correct to say that you might require to put in mechanical haulage where horses could not stand the high temperature?—We might. I should very much prefer mechanical haulage anywhere that we could put it in, whether horses can stand it or not.

18860. I think it would certainly be cheaper for the company if you had mechanical haulage than it would be with horses?—I think what Mr. Knowles said at that meeting was that we had recently put down a pair of new air compressors of the most modern construction, which were supposed to be the finest pair that the manufacturers had turned out, and that we had been extending our haulage and found it necessary to put this additional pair of air compressors down. I think that was what he said, and that was quite true.

18861. Was that auxiliary to your fans on the surface?—We had air compressors on the surface, which were not large enough; we had extended our workings and extended our haulage, and we found ourselves a little short of compressed air, and consequently we put down another slightly larger pair in addition to what we already had on the surface.

18862. You have not had auxiliary fans underground?—No.

18863. And you have had no complaint of the horses not being able to stand that temperature?—We have no horses down that pit.

18864. You have no horses where your temperature is high?—No. We have only two ponies in the pit, and they are employed at the pit-bottom just to pull the boxes about the pit shaft. In two of our largest collieries we have no horses at all underground.

18865. Then you must have hand drawing or putting from the face to your haulage roads?—Very little. It is nearly all mechanical—either self-acting inclines or rope haulage.

18866. (*Dr. Haldane.*) With regard to the effects of high temperatures underground upon horses, I think it is a well-known fact that horses are often in danger where men are not?—That is so. There is something peculiar about the horse which I have not been able to get anyone to explain yet, but in those very confined and very hot mines horses are liable to something which affects their lungs, and they die very suddenly—a sort of congestion takes place.

18867. I think they die simply of what is called heat apoplexy—I mean by reason of a simple rise of body temperature?—I do not know what it is, but I have had them opened after they have died in that way, and I have always found that their lungs were turned into a hard black substance—thoroughly congested.

18868. Yes, congested, but I think it is the same thing as heat stroke. Do you not think the explanation is simply this, that the horses have got to work and are made to work when perhaps the heat is too much for them, whereas you cannot make a man work, as he simply will not do it?—I think the places where the horses work are not so hot as where the men work, as a rule.

18869. No, but a horse may be over-driven without a man knowing it?—Yes, I think you may be right about that; we cannot always watch the horses, and the men do not always take as much care of them as we should like. They may overdrive them occasionally in that way.

18870. I think it would be difficult to prevent that happening sometimes; the only thing you could do would be to take their temperatures now and again?—Yes. We follow the principle of abandoning the use of horses as much as we can, especially in these hot mines.

18871. I never heard of a miner getting heat stroke anywhere, even in the Cornish mines, which are much more formidable on account of the moisture, although horses commonly do get heat stroke, just as soldiers who have to do what they are not inclined to in hot weather. Are the men able to do a full day's work in a temperature of 92 to 98 degs., do you think?—Yes.

18872. I mean their output of coal for the day is about the same?—It is about the same. It makes very little difference when they get acclimatised to it. The men who work in those mines have to get accustomed to it, and it would not suit every man; it takes a little time

Digitized by Google

for them to get accustomed to the temperature, and when they have got acclimatised to it they are all right.

18873. You cannot give us a rough idea of the wet bulb temperature at these parts, can you?—Yes, I can give you an idea of it; I have a series of experiments here showing both the wet and dry temperature, and also the strata temperature.

18874. In working places?—Both in main roads and in the working places. The dryness of the atmosphere runs from 25 degs., which is about the driest. In the hottest mine we have in some places which we call "stocken" places, we have very high temperatures. I do not know whether you understand what a "stocken" place is; it is a place that is being cut through to another place, and has not yet got through so as to make a communication, but it is in process of being made: there for a certain time you are dependent upon what air you can carry through with the brattice into it. In some of those places we have a temperature, as it was last taken, of 107½ degs.; that is the highest temperature that I have ever known men to work in. In that case the dryness of the atmosphere was 28 degs.

18875. That is 28 deg. difference between the wet and dry?—No, that is degree of humidity.

18876. 28 deg. of humidity?—Yes. The difference between the wet and dry bulb is 107½, and 82 deg.; and in that particular atmosphere there was 6·25 grains moisture in the atmosphere per cubic foot—of vapour.

18877. Would that figure of 82 deg. for the wet bulb be fairly representative, or was that high for the wet bulb temperature?—Yes, that is an extreme for wet bulb.

18878. Usually the wet bulb is below that?—Yes. That is the hottest mine we have.

18879. Then what would the natural temperature of the coal be in those places?—The temperature of the strata?

18880. Yes, the natural temperature—I mean not the actual temperature at the time, but the temperature in the virgin coal before it has been opened up?—Of course we cannot get the temperature until it has been opened up for some little time.

18881. You can put a borehole into virgin coal and get the temperature there?—I can give you the temperature at the greatest depth that we are working, if that would assist you, and also at the extreme face—we may say perhaps the normal heat of the hot places; at that place it is 3,651 feet below the surface; the dry bulb is 92 deg., and the wet bulb is 74½ deg.

18882. That is the air. Have you got the original temperature of the coal there?—100¾ deg. is the temperature of the strata at that same place.

18883. Was that at a face?—Yes, a working face.

18884. A longwall face?—Yes.

18885. So that the air temperature was nearly 10 deg. below the original temperature of the coal, probably?—Yes, 8¾ deg.

18886. With regard to the effects of watering on the possibilities of work in a mine, of course there is no doubt that what you have said on that subject is correct so far, but I put this to you: if you water at any point it reduces the temperature very much just at that point, does it not?—Yes.

18887. You get an enormous reduction, and I suppose with a spray you could bring the temperature down 30 deg. or 40 deg.?—No, nothing like that.

18888. I think you could do close upon that—for the moment?—I do not think so, because I think by the time that we got the water to the place, the water itself would be getting 70 deg. or 80 deg. of heat, and it would take it up.

18889. But it would not much matter whether you used boiling water or not for spraying—you could get the temperature down just the same?—By the effect of vaporising.

18890. Yes, in fact in Lancashire at spinning-mills they do use boiling-hot water to bring down the temperature. You would get a local effect of that sort; I mean whatever it is, you know that it is produced?—Yes, it would produce some little effect, but it would be very small I think.

18891. It would not last for long if you suddenly started watering one particular point, but it has a very powerful effect on the place. I think that is true, is it not?—Well, you have to consider the volume of air that is passing at the point.

18892. You would cool down that large volume of air?—You see you would have a large volume of air passing, and it would require a tremendous quantity of water to bring down the temperature of a volume of air like that passing.

18893. Not so very much. But what I wanted to get at was this: I do not think it follows from the observation which you have quoted to us that the effect of systematic watering would be at all as bad as the effect of that particular case, because systematic watering would cool down the mine as a whole, you would cool down your roads and everything, and you would reduce the temperature very much. I think that is the experience of watering in mines in Germany—that it reduces the temperature?—It would have to be on a very extensive scale in order to reduce the temperature of a volume of air which is passing through a mine like that. Supposing in a road like that you have 20,000 cubic feet of air per minute passing through you would require a very considerable volume of water to reduce that 30 deg. or 40 deg.

18894. It would not be so very much water when you come to calculate it out. I put that to you as rather a source of fallacy in your argument?—Then there is another question with regard to that, namely, how long would the effect of that last in the road when the air was travelling through a further length of road at a high temperature: would it not very quickly assume the temperature of the strata it is passing through?

18895. It would cool down the walls of the road and a large layer beyond that; but that is pretty much what you want in a deep mine; you want to cool down all your main roads so that you get the air cool to the men at the face. I think you told me during the adjournment you found the temperature of the roads gradually fell as you continued the ventilation through them?—Yes, but the effect of that is very slight; it only goes to a few degrees in perhaps five or 10 years; it is not an immediate effect.

18896. In the case which you quoted just now, there was a difference of 8¾ deg. even at the working face without any watering?—We find that to be always the case wherever we try it; we always find the temperature of the strata is higher than the temperature of the current of air which is passing through it. Naturally it must be so, because the current of air is taking its heat from the strata and it must be the less, taking from the greater.

18897. Yes, it must be, so long as the ventilation is good. But you are aware that the amount of heat which air will absorb (especially at that temperature) through evaporation, is enormously greater than the amount of heat which it will take up by simple warming?—Yes.

18898. I mean the dryness of the air has a very much greater cooling effect, or may have a greater cooling effect than the mere lowness of its temperature?—Do you mean that the increased heat of this air will absorb more moisture.

18899. Yes. it takes up a great deal of moisture, and therefore renders latent a great deal of heat?—Yes. that is so; because we find where we have 35 deg. of humidity, for instance, we have 6¼ grains of moisture to the cubic foot, due of course to the increased heat of the atmosphere which takes in a larger amount of vapour without affecting the physical humidity of it.

18900. That larger amount of vapour taken up by the air represents an immense disappearance of heat and an immense cooling effect of the mine?—Yes; that is visible in the instance which you asked me for, where we have got nearly 9 deg. difference between the temperature of the strata and the temperature of the air passing through it.

18901. You might increase that effect very much by watering?—There is another very curious point which I may mention: before the former Coal Commission I put in some diagrams showing the temperature of the air in its course from the pit, through the workings back again to the pit, and there you will see by the curved lines that the temperature of the air increases as it goes through the workings until it gets to the hottest point, but then from the farthest point of the workings on its road back again to the pit, the temperature decreases; it does not go back to the normal that it started from at the pit, but it retains a certain amount of the heat; but you will find that it parts with a very great deal of the heat that it has picked up in the mine before it leaves it.

18902. But there is another possible interpretation of that fact, namely, that there is a great deal of leakage across from the intake and returns?—Yes, no doubt that is so in some mines.

Digitized by Google

Mr. Henry Bramall.

1 May, 1907.

18903. It is so in some mines ; there is sometimes 80 per cent. of leakage of air ?—We have no such leakage as that, or we could not keep the mines working.

18904. No, I do not suppose it would be so in your case, but I could quote you a case to that effect. In connection with the experiment with calcium chloride, did you inquire whether you could do it any cheaper with magnesium chloride ?—No.

18905. I do not know which is the cheaper substance ?—The calcium chloride costs 30s. per ton at the works. I do not know what the magnesium chloride costs.

18906. I suppose the calcium chloride at 30s. per ton is moist ?—No, it is solid, in drums.

18907. Could it not be bought more cheaply if it were not bought solid ? I suppose it would have to be evaporated in that case ?—There would be the extra carriage in that case, and the carriage is a considerable item to us ; 11s. 4d. per ton is the amount that is added to it for the carriage, and if you bought a solution you would of course be paying carriage upon water.

18908. (*Mr. Cunynghame.*) I have heard it said sometimes with regard to watering that it will only affect the outer layer of the road, but if that fell and you went on watering, no further fall would take place. How far is that true ? Do you follow the point, that there might be some falls at once, but that after that no further falls would take place at all, and it would not continue. I put it to you, but I have no opinion upon the matter myself ?—I think that is not so. Of course there are different circumstances of mines ; it is impossible to give an opinion of any value upon a case stated in that way.

18909. But I am asking whether that is true as a general proposition ?—If the roof was homogeneous I should say that the falls would continue.

18910. (*Mr. Wm. Abraham.*) How long are the men working as a rule in the dry atmosphere which you have told us of ?—They are in it for about eight to nine hours.

18911. Working in that high temperature ?—Yes, about eight hours.

18912. In the working places ?—Yes.

18913. Then it does not affect them very much, does it ?—No.

18914. In fact working in that temperature has not any effect at all upon them ?—They are as healthy a lot of men as you would wish to meet with.

Mr. MATTHEW HENRY HABERSHON, called and examined.

STATEMENT OF WITNESS.

Mr. M. H. Habershon.

18914A. I am a Fellow of the Geological Society ; Member of the Institution of Mining Engineers, and certificated Colliery Manager ; Mining Engineer at the Collieries of Messrs. Newton, Chambers & Co., Limited, Thorncliffe, near Sheffield, and I have had over 30 years' practical experience in coal mining.

(1) My attention was first directed to the subject of breathing apparatus for collieries in 1898, when it was suggested that several adjacent collieries should establish a joint station at which apparatus should be kept and maintained, for use in emergency, and where men from the collieries concerned could be trained to use them. After due consideration Messrs. Newton, Chambers and Co., Limited, the Barrow Haematic Steel Co., Limited, and the Wharncliffe Silkstone Colliery Co., Limited, decided in June, 1901, to build and equip the Tankersley Rescue Station at Birdwell, situated in a central position for their pits, which are in the immediate neighbourhood. The argument was advanced that the station would be too far from some pits to be of real value in case of necessity, and the combination was not so inclusive as was at first hoped. This argument was however, a fallacy, but the possibilities were not at that time realised. The station was last year joined by the Strafford Colliery Co. As it was felt that the station was largely experimental, a small building only was erected at a minimum cost.

(2) The question of rescue stations has also been considered by a Committee of the Midland Institute of Mining Engineers, who made a short report in August, 1899 ("Trans. Inst. Min. Eng.," p. 74, Vol. XVII.), but the subject has remained in abeyance. With the view of having the question thoroughly discussed and obtaining the opinion of those who had experience in the matter I read a Paper before the Midland Institute of Mining Engineers at Sheffield, in March, 1901, in which the arguments for the establishment of joint colliery rescue stations were fully set forth, with a number of suggestions and rules for the formation and working of the same. I hand in an excerpt copy of this Paper, which is contained in "Trans. Inst. Min. Eng.," Vol. XXI. p. 100.

(3) After seeing a demonstration at Shamrock Colliery, at Herne, in Westphalia, in September, 1902, of the use of the Giersburg 1901 type of apparatus, five sets of this apparatus were obtained for the Tankersley Rescue Station and an ex-Army sergeant engaged as caretaker and instructor was thoroughly trained at Shamrock Collieries in the manipulation and wearing of the apparatus. I also contributed a Paper to the Midland Institute of Mining Engineers in November, 1904, giving some particulars of the cost of the equipment and practices, and of the experience gained in the attempt to train men to wear it. I hand in an excerpt copy of this Paper which is contained in "Trans. Inst. Min. Eng.," Vol. XXVIII. p. 254.

(4) The funds available for working the station have been extremely limited, and the work done has been largely of an experimental nature. We have obtained and tested various improved apparatus as these have become available, and have trained up to the present time about 60 men in all from the four Companies connected with the station, which is, however, not yet adequately equipped with a sufficient number of up-to-date or reliable sets of apparatus for use in any emergency, as those first obtained, and also some of the later ones are now obsolete, they are unreliable, and do not permit of a performance of hard work for a reasonable period of time.

(5) I recently, on the 9th April, read a Paper before the Midland Institute of Mining Engineers, on the use and care of oxygen breathing apparatus in which I pointed out the essential requirements which must be fulfilled by such apparatus, and explained the great care necessary to keep them in order : the troubles which are liable to be met with, the possible causes of failure, and the tests required for imperfections and leakages ; this Paper being a *resumé* of the experience gained at Tankersley Rescue Station during the last few years. It has not yet been published in the transactions, but I hand in an advanced proof.

(6) The Tankersley Rescue Station is at present the only joint colliery rescue station in the country, and the only place at which an attempt has been made to train a considerable number of men.

(7) I am familiar with Mr. Garforth's experimental gallery at Altofts where a few men have been very highly trained. Men from Tankersley station have on several occasions taken part in demonstrations of the use of apparatus in this gallery.

(8) I put in a record of work done in a test in this gallery on the 23rd March, when four men from the Tankersley Station wearing "Draeger" apparatus competed with four of Messrs. Pope & Pearson's men wearing the "Weg" apparatus. This recorded test showed that suitable trained men could in a noxious atmosphere walk a considerable distance, move heavy stones, climb over falls, and bring out a dummy man on a sledge stretcher through a short length of 2 ft. diameter air tube and over the falls, besides performing considerably over 100,000 units of work each, wearing either the "Draeger" or "Weg" apparatus without any symptoms of distress.

(9) In connection with the Tankersley Station several underground practices have been held, as well as frequent practices at the station in a noxious atmosphere in which brickwork stoppings have been built, brattice cloth nailed up, and timber sawn. We have used the "Shamrock" apparatus, the Giersberg Helmet, as well as the "Draeger" of both the helmet and mouth-breathing type. We have also tried the "Pneumatogen" but have had no experience with the "Weg" apparatus,

Digitized by Google

which is still in somewhat of an experimental stage and not yet standardised.

(10) I give the following particulars of tests which have been made at the Tankersley Station:—

Duration Tests:—5th March, 1907, W. Clifford (Strafford Collieries) wearing the "Draeger" apperatus, mouth-breathing type—4 hours 3 minutes; did no work. 4th April, 1907, J. Anderson (Barrow Collieries) wearing the "Draeger" apparatus, mouth-breathing type—5 hours; walked 7,400 yards. At the conclusion of this test he was very hungry. This appears to be the most noticeable effect of wearing the apparatus for any long period of time.

Exertion Tests:—5th March, 1907, W. Clifford (Stratford Collieries) wearing the "Draeger" mouth-breathing type, sawed a quantity of wood clogs, built brick stoppings, crawled through 50 yards of contracted passages (18 in. by 19 in.) dragging a load of 56 lbs. walked 2,000 yards, ran 2,402 yards, and had one short rest, in 2 hours and 20 minutes. 19th March, 1907, J. H. Thorne (Wharncliffe Silkstone Collieries) wearing the "Draeger" apparatus, helmet type, raised a 56 lbs. weight to a height of 7 ft. 600 times in one hour and fifty minutes. 235,200 foot pounds of work. 20th March, 1907, J. Anderson (Barrow collieries) wearing the "Draeger" apparatus, helmet type, raised a 56 lbs. weight to a height of 7 ft. 610 times in one hour and forty minutes—239,120 foot lbs. of work.

(11) The station has been visited by a Committee of the Lancashire Coal Owners; by representatives of other South Yorkshire collieries and by several inspectors of mines, and I think that several similar stations would probably have been decided upon and perhaps commenced before now, but am afraid that the question having been referred to the Royal Commission has caused a slight check, and that the Report of the Commission would now be waited for. Still I know of two cases in which definite action has been taken towards joint stations.

(12) I think there are now several types of oxygen breathing apparatus which might be considered useful in many cases, if they were constantly under the supervision of a competent man, who thoroughly understood the principle of their action, and all the details of their construction and knew where to look for imperfections, and if they were kept in regular use and worn by suitable men, who had been thoroughly trained. The apparatus is, however, very delicate and liable to get out of order, and so to become only a death-trap unless the greatest care is taken to see that they are in perfect order on every occasion when used.

(13) I think the cases which have been reported of misadventures only emphasize the necessity for stations at which men could be properly trained by a competent instructor, and all apparatus overhauled and maintained in proper order. All men are not constitutionally suitable to be trained to wear breathing apparatus, and I think it is a matter which cannot be mixed with ordinary ambulance training.

(14) The great danger to be feared in connection with the establishment of rescue stations is that after the lapse of any length of time during which no call might have been made on a station the work of practice might become lax, or conducted in a perfunctory manner, and the apparatus, not being regularly used in rotation and overhauled, would get out of order. This condition not being realised, a false sense of its value would be induced, and in case of a sudden call the consequence might be disastrous. I would, therefore, strongly deprecate any suggestion that apparatus should be generally kept at collieries in any ratio to the number of men employed, or any similar suggestion. It is a question which should be dealt with very carefully; otherwise false confidence might be established and failure would certainly result.

(15) Any apparatus kept in a colliery store for only a few months and not periodically overhauled and regularly used and so brought under the notice of a man specially trained for this purpose, would be worse than useless.

(16) The development of reliable apparatus with which hard work can be done is quite recent, and at present there are very few men who have sufficient experience in the manipulation of them. It is largely in Germany that this development has been brought about, and I think the German Government have recognised the desirability of maintaining an attitude of caution in the matter, inasmuch as they have not yet seen their way to suggest any compulsory measures in regard to rescue apparatus in connection with the large collieries in that country. I think the feeling in this country on the matter will grow with greater experience, and that it would be unwise to force it unduly.

(17) I hope, therefore, that the Commissioners will not make any recommendations which might involve an outlay in advance of the necessary experience, and out of proportion to the possibilities of what could be safely aimed at, and I suggest that if any stations were eventually established it would be the duty of H.M. Inspectors of Mines to visit them in order to see that they were maintained in a state of efficiency.

18915. (*Chairman.*) You are mining engineer at the collieries of Messrs. Newton, Chambers and Company, Limited, and you have had over 30 years practical experience in coal mining. Have you had experience elsewhere?—No, my experience has been entirely at the collieries of Messrs. Newton, Chambers and Company.

18916. You state that after due consideration the rescue station was decided upon in June, 1901?—Yes.

18917. You mention the titles of various papers which you have read before the Midland Institute of Mining Engineers on the subject of rescue stations?—Yes.

18918. You have handed in copies of those papers, I understand?—Yes.

18919. You say that after seeing a demonstration at the Shamrock Colliery in Westphalia in September, 1902, of the use of the Giersburg 1901 type of apparatus, five sets of this apparatus were obtained for the Tankersley rescue station, and that an ex-Army sergeant was engaged as caretaker and instructor and thoroughly trained at the Shamrock Collieries in the manipulation and wearing of the apparatus?—Yes.

18920. You have tested various improved apparatus as they have become available, and have trained up to the present time about 60 men in all from the four companies mentioned connected with the station?—Yes.

18921. You go on to say that the Tankersley rescue station is at present the only joint colliery rescue station in the country and the only place at which an attempt has been made to train a considerable number of men?—Yes.

18922. But you seem to have done a good deal in the way of training men at the Tankersley Station, and you have taken very great pains to find out all about these rescue apparatus?—Yes. The last paper which I wrote and which I have just handed in, gives an account of our experience with various types of apparatus which has not appeared before anywhere else, and I thought that perhaps would be of interest to the Commission.

18923. Certainly. Then you say that in Mr. Garforth's experimental gallery at Altofts a few men have been very highly trained, and you say that men from the Tankersley station have on several occasions taken part in demonstrations of the use of apparatus in that gallery?—Yes.

18924. In the course of those demonstrations has there been any serious accident happen to any of the men while using the apparatus?—No, none. I have here copies of a test we made on March 23rd of this year, which is perhaps the most severe test that has been made in England of apparatus of this kind.

RECORD OF WORK DONE WITH BREATHING APPARATUS IN THE EXPERIMENTAL GALLERY AT MESSRS. POPE & PEARSON'S COLLIERIES AT ALTOFTS ON MARCH 23RD, 1907, BEFORE MEMBERS OF THE MIDLAND INSTITUTE OF MINING ENGINEERS AND THE YORKSHIRE BRANCH OF THE COLLIERY MANAGERS' ASSOCIATION.

PROGRAMME.

Four men to walk each 100 yards, creep on hands and knees 50 yards, then to pick up 40 lbs. stretcher, carrying same through narrow roadway, removing stones weighing 40 to 80 lbs., crawl through 2 ft. diameter air pipe, 6 ft. long. Pick up dummy man 160 lbs. weight, place same on stretcher, and carry loaded stretcher back to entrance of gallery. Two of the men to return to furthest point carrying fire extincteurs, and to occupy the rest of the time fixing timbers and bratticing. The other two men to lift a 56 lbs. weight to a height of 6 ft. repeatedly.

This programme was carried out by four men from Messrs. Pope & Pearson's Collieries wearing the "Weg" apparatus and afterwards by four men from the Tankersley Rescue Station wearing the "Draeger" apparatus. The time allotted in each case was 2 hours and 15 minutes.

Digitized by Google

Mr. M. H. Habershon.

1 May, 1907.

SUMMARY OF WORK DONE.

——	"Weg."	"Draeger" 2 Helmet Type, 2 Mouth Breathing Type.
Walking	1,760 yards	384 yards*
Creeping	320 ,,	384 ,,
Travelling over falls	600 ,,	570 ,,
Creeping through contracted passages	80 ,,	—
Creeping through air pipe...	23 times	14 times
Carrying fire extincteurs ...	8 ,,	2 ,,
Fixed bratticing	Once	Once
Lifting 56 lbs. weight 6 ft.	588 times	762 times
	—197·568 ft.lbs. (two men)	—256·032 ft.lbs. (two men)

* These men did not know that any further distance walked would be recorded.

"Weg."—One man came out at the end of 1 hour and 11 minutes owing to a breakdown in his apparatus, returning after being out 14 minutes.

"Draeger."—One man came out at the end of 1 hour and 39 minutes, his apparatus not working well.

I should remark that in this test, although these four men from the Tankersley station and four of Mr. Garforth's men remained in the gallery for upwards of two hours—2¼ hours—yet in each case one man had to come out before the full period. In the case of the "Weg" apparatus there was some breakdown with one of the apparatus, and in the case of one of the Tankersley men he found that the apparatus was not working properly and he came out after being in for an hour and thirty-nine minutes.

18925-6. How long had the man with the "Weg" apparatus been in?—One hour and eleven minutes. The other men remained in the full time and could have stopped much longer. But this shows that even with the most carefully trained men and the most perfect apparatus that we have in this country at the present time we are liable to have these little difficulties occurring; and I wish to call the attention of the Commissioners to the fact that therefore a very great deal of care indeed is required to keep the apparatus in order.

18927. You say that four of these men went into this atmosphere with their apparatus which was warranted to last them for breathing 2¼ hours?—Yes.

18928. And that two out of the four had to come back again?—Yes.

18929. If they had been a long way down in the middle of a mine with a long walk, say, of an hour wearing this rescue apparatus, they would not have been able to come back again?—No, I do not say that. In the case of the "Weg" apparatus there was a breakdown and that man could not have come back, but the man wearing the "Draeger" could have come back. He found that the thing was not working very well, and he thought it would be prudent for him to come back, but he thought he could have remained in much longer, and, as a matter of fact, we examined the apparatus and found that he could have remained in much longer, but he was not so experienced as the other men.

18930. You think it was partly because he was not so experienced?—I think so. I think it was through his own neglect, partly, and the way in which he used the apparatus, that he had any difficulty.

18931. Then you give specimens of duration tests in paragraph 10 of your statement and some of those seem to be very satisfactory?—Those are very satisfactory indeed.

18932. In referring to the test of the 4th April, 1907, you say that the man wearing the "Draeger" apparatus, mouth-breathing type, wore it for five hours and walked 7,400 yards, and that at the conclusion of this test he was very hungry. I should think any man who was walking for five hours would have been very hungry?—But even if he had been sitting down doing nothing he would have been very hungry. That experience has been confirmed by Mr. Garforth; he says that a man using the apparatus for six hours and doing nothing whatever became very hungry. That is the case; breathing the oxygen for that length of time tends to make a man very hungry.

18933. Then you say that in one case on the 5th March, 1907, a man wearing the "Draeger" apparatus sawed a quantity of wood clogs, built brick stoppings, crawled through 50 yards of contracted passages, dragging a load of 56 lbs., walked 2,000 yards and ran 2,402 yards. At what sort of pace did he run? He could not run at much of a pace with that on his back, I should think?—He ran at a decent speed. Of course the weight which is carried is not more than 30 lbs., and a man can run with 30 lbs. weight.

18934. At all events, this man in 2 hours and 20 minutes did a very considerable amount of work?—Yes.

18935. The general result of it seems to be that when a very experienced man puts on a good apparatus the chances are that he would be able to do a fair amount of hard work for 2 hours, or even more, but it is quite possible that if he is not very experienced he will have to stop after an hour or so, and it is quite possible also that something may happen to the apparatus?—I think it is possible that he may have to stop owing to some defect in the apparatus. I do not think that a trained man with a perfect apparatus to start with will have to stop under 2 hours; he may stop in more than that if it is simply a duration test, but if he is doing hard work, 2 hours to 2¼ hours is about the limit for hard work. But the danger to be feared is that some little thing may be wrong in the apparatus which has not been discovered and that may shorten the period for which the man can remain.

18936. Have you any information which you can give us as to the advantage of one kind of apparatus over another in your tests?—I think it is narrowed down to a very limited number.

18937-8. But with regard to that limited number you say they are all fairly reliable?—The only two that I give any tests with are the "Draeger" and the "Weg"; and the "Weg" apparatus is not on the market at the present time. The "Weg" apparatus has not been standardised; they made a number of them and each one is different from the previous one, and it is still in the course of development; it is somewhat complicated. The "Draeger" apparatus is standardised; and I learnt only yesterday from Westphalia that at the large station at Gelsenkirchen they are now adopting the "Draeger" apparatus.

18939. Having tried all the others?—Yes. At the Courrières explosion Herr Meyer had the "Shamrock" which we have experimented with at our station, and we found for ourselves, and we found out at Altofts also, that it will not permit a man to do hard work. The "Draeger" will, and Herr Meyer is endeavouring now to bring the "Shamrock" apparatus up to the standard of the "Draeger."

18940. But at the present it is not up to that standard?—Well, I do not know that. I saw in Sheffield three weeks ago one specimen of a new "Shamrock" apparatus which I think will probably enable a man to do hard work; but this, while it embodies several marked improvements, has not yet been tried, in fact there has only been one made at the present time; We have ordered one, but cannot get it yet.

One of the points which I speak of in the last paper I have handed in is the danger of rust inside the oxygen cylinders which is liable to cause a premature stoppage of the apparatus, especially if the apparatus is filled by displacement with water—and that is a very subtle danger, which does not manifest itself all at once. A particle of rust might get into the injector and stop the apparatus. With the new "Shamrock," which has not yet been put on the market, they have commenced to plate the inside of the cylinders, and that will of course effectually prevent rust being formed.

18941. That might be adapted to the "Draeger," might it not?—Yes, it might, of course; but the Draeger Company say they prefer to fill the "Draeger" apparatus by a different arrangement of high pressure pumps in which water is not used. That is a new idea since we bought our plant, and of course we have not money to spend recklessly in buying everything when it comes out, so that we have had no experience of it. It is not so economical; there is some waste of oxygen. Therefore, if you could plate the inside of the cylinders so that there is no fear of rust developing, you could adopt the method of charging by displacement with water and not waste the oxygen.

18942. But then you might very well apply this "Shamrock" method to the "Draeger" method so far as putting

Digitized by Google

the oxygen into the receptacle is concerned?—Yes, they could be plated; I do not know whether there is any patent for it or not.

18943. You are inclined to think that this new "Shamrock" apparatus might be quite as good as the old "Draeger"?—Well, I will come back to your original question and deal with that; you asked me what apparatus there are. I say there is the "Draeger," which we know is reliable; and there is the "Weg," which Mr. Garforth has in his own hands entirely, and which is not yet on the market, so that I have no experience of it; I have seen it used, and I can give you the results which have been obtained at his gallery. Then I say there is the new "Shamrock," which I have seen, and I am going to try it when I get hold of one. I think probably it will be equal to the "Draeger" and it certainly embodies one or two very valuable improvements.

18944. Those are the three?—Those are the only three that I have experience of.

18945. You go on to say in your Statement that the apparatus is very delicate and liable to get out of order?—Yes.

18946. Do you mean all the apparatus you have tried? I do not understand to what apparatus that refers?—To any apparatus.

18947. That is to say, "Draeger," "Shamrock," or any of them?—Yes.

18948. You say that they may in that way become a death-trap unless the greatest care is taken to see that they are in perfect order on every occasion when used; and you say that the cases which have been reported of misadventures only emphasize the necessity for stations at which men can be properly trained by a competent instructor and all apparatus overhauled and maintained in perfect order?—Yes.

18949. Then what would you suggest as regards instruction and maintenance of apparatus; what sort of precautions would you take?—I think it would be necessary to have at every station a thoroughly competent man who understands the principle of the apparatus and the method of overhauling and repairing them. That is very essential indeed, although it may be difficult to get such men at the present time. If stations were established in the different districts, I would suggest that a properly qualified man should visit the stations periodically to see for himself, by simply testing, that the apparatus are all right.

18950-1. You mean that perhaps one man or two or three men might go about testing these apparatus from time to time, and that they need not be permanently attached to any particular station?—That is what I mean. A man might go to a number of stations and he could test all the apparatus at a station in one day or a couple of days.

18952. How often would he have to go round, do you think?—I have hardly thought it out; it depends upon how many stations you have and the number of apparatus in a station.

18953. You say "I therefore strongly deprecate any suggestion that apparatus should be generally kept at collieries in any ratio to the number of men employed, or any similar suggestion." I do not understand the "therefore" there?—I wanted, rather, to bring you to that point; my theory is that if you put apparatus at a colliery and keep it there you will find probably after a month or so some little thing will be out of order in the apparatus and that an ordinary instructor or man in charge will not be aware of that; then a sudden call might be made for the apparatus, and the manager who is responsible might send a man down the pit in that apparatus without knowing it is out of order. I should like to ask you to consider carefully this question of responsibility having regard to that.

18954. Yes, but I do not quite understand what you mean by "I would therefore strongly deprecate any suggestion that apparatus should be generally kept at collieries in any ratio to the number of men employed, or any similar suggestion"?—The point I was trying to get at was this; I have a strong preference for joint rescue stations where apparatus can be kept in proper control and proper order by a responsible person.

18955-6. You mean to say there ought not to be many stations scattered about. That is your point?—No, I would rather put it in this way, that you should have joint stations in preference to allowing individual collieries to keep their own apparatus. In my Statement I say that in the first instance the argument was advanced that these apparatus would be of no use because they were not at the colliery and would not be there when they were wanted. I say that is a fallacy, for this reason; assume that you have apparatus at the colliery and some disaster takes place—there is generally some little time before any persons in authority can act—they cannot act for an hour or so, and it takes a little time to get things into order, and supposing you have the apparatus there, your men may not be there. Supposing you have a certain number of men trained, half of those men would be in the pit and the other half would be at home at their houses, probably asleep, and you would have to get them to the colliery. I say that as soon as you can get your men there you can get your apparatus there from the station; it is no use having the apparatus there before the men.

18957. That would depend upon how far off the station was?—A station for half-a-dozen collieries or so would probably have a motor car attached to it, and would be in telephonic communication with the collieries, and you could probably get your apparatus there within three-quarters of an hour from a reasonable distance. The important point to be considered, in my opinion, in connection with the distance of a station from the collieries is the question of the men getting there for purposes of practice.

18958. (*Mr. Wm. Abraham.*) But you suggest that, independently of the question of station whether the apparatus is at a colliery or a certain distance away, having regard to the possibility of a little thing going wrong in the apparatus, it would be necessary to test every apparatus before it is used?—Yes; and if you have a station with a competent man who knows everything about the apparatus and has them under his eye, and they are all used in rotation, and he has overhauled them in rotation, he can always have five sets of apparatus which he knows are in perfect order at any moment.

18959. (*Chairman.*) Then I understand you must have a man who does understand all about it at every station?—Yes, at every station.

18960. And you suggest in addition a person of superior qualifications who could visit each station in turn?—Well, that is simply a safeguard, because at the present time you have not got sufficient men to put at the stations: of course you would educate such men gradually.

18961. Then directly you have the men at the stations, the additional man would be unnecessary? Supposing you do eventually obtain in this country stations in the various districts, there is the question of responsibility to consider. You cannot take the responsibility out of the hands of the colliery manager; and it is a question which I think ought to be carefully considered as to who is to be responsible in law for a man putting on an apparatus.

18962. (*Mr. Wm. Abraham.*) Is not the first and principal question the question of getting safe apparatus, and, according to what you say, is it not necessary that it should be tested before any man is entrusted with it?—Yes.

18963. (*Chairman.*) I suppose your position is this, that you cannot get a perfectly safe apparatus, that is to say, an apparatus which does not require, in order that it may be perfectly safe, that it shall be constantly tested and tested in every case immediately before it is used: that is to say, supposing you have five sets of apparatus in a place, which have been tested a few weeks ago, they should be tested again in every case before a man is allowed to go into a pit with one of them?—I think a competent man, such as I speak of, at the station would issue out his five sets in five minutes and guarantee that they were in perfect order. The number of men who can do that at the present moment in this country can be counted on your fingers, or they are even less in number than that.

18964-5. He would be able to guarantee it without putting it on a man and testing it by his breathing through it?—Yes; he could find it out in a minute. But there is no apparatus which is sufficiently advanced or perfect to avoid this necessity existing at the present time.

18966. (*Mr. Ratcliffe Ellis.*) When you speak of responsibility, do you mean the responsibility for any misadventure at a gallery, or the responsibility for any accident that might happen when a man went down a pit with one of these apparatus on: you mean the second, I take it?—Yes, the case of a disaster in a colliery.

18967. What is the responsibility for allowing men to go

Digitized by Google

Mr. M. H. Habershon.

1 May, 1907.

down the pit at all after an explosion ?—I am simply thinking of the position of the colliery manager under the Mines Act ; he must know what he is doing.

18968. (*Mr. Cunynghame.*) I suppose your plan is somewhat of this nature : you advocate rather what I may call fire brigade stations with everything splendidly fitted and splendidly kept and a few of those stations at points from which men either by road or by rail can rapidly get to the colliery, and you would suggest that there should be a few such stations perfectly equipped with men ready to start at a moment's notice like a fire brigade, rather than putting down a whole lot of apparatus all over the place to be used by men who might not be fitted to use it at a moment's notice, and who might be incapacitated directly in the use of it ?—Yes, but I do not quite agree with the expression "fire brigade." I think the men who constitute this party must be trained men from the pits.

18969. But would you not have at the station a certain number of men who can go with the apparatus and put it on, and then they would be joined at the pit by men who were there and who would know how to use the apparatus, perhaps not so perfectly as the men whose whole time is taken up in the care of it, but who might help them ?—No, I think that is not quite it. You have perhaps half-a-dozen collieries that are interested in a joint station covering a certain radius ; those individual pits send their men once a fortnight or so to be trained, and perhaps in the case of a large colliery they have say 50 men who have been trained in the use of the apparatus. That would give you 10 sets of five, so that you would have 50 men trained. That would give you 10 parties of five men each. The manager of the colliery would understand that he must not have all those 50 men in the pit at the same time, and he would have half on his night shift and half on his day shift. Then assume that an accident happens and the manager wants to make use of the rescue party, he telephones to the station and says "Send me apparatus immediately" ; then he also gets his men on the spot and as soon as he has got his men there the apparatus is there ; then he puts five sets of apparatus on five men ; the man who is in charge of the station would come to the colliery with the apparatus and would himself fit on those apparatus to those five men and say "Now those men are all right and ready to go down."

18970. (*Mr. Ratcliffe Ellis.*) What objection would there be to have a certain number of apparatus at the colliery ? —I am afraid you would never get them taken care of.

18971. Is that the only difficulty ?—I have known cases happen where an apparatus has been at a colliery and in a very short time indeed it has been utterly ruined.

18972. (*Chairman.*) Then I understand as regards the division of responsibility the man who would be in charge of the station and who would be an expert, would be responsible for the apparatus being in proper order, and for their being properly fitted on the men ; and there his responsibility would cease, and the manager of the mine would be responsible for allowing the men to go down the mine with the apparatus on ?—Yes.

18973-4. That would be a different responsibility, of course ?—Yes, that would be a different responsibility.

18975. (*Mr. Cunynghame.*) Supposing the apparatus is sent for, surely it would be expedient that a man should come with the apparatus who was perfectly expert in the use of it, and who would be able to pass everybody wearing it before they went down ; it would be a most important thing that he should look over it, and be able to say "You are all right." Surely three or four men who were thoroughly skilled mechanicians would be able to go out with the apparatus, even although they had been instructed recently ?—Yes ; one man who would be in charge of a station would go with the apparatus to the pit, and he would fit them on the men.

18976. (*Chairman.*) And go down the pit with them, do you mean ?—No, not go down the pit with them.

18977. (*Mr. Ratcliffe Ellis.*) You would have a training station, I take it, where you would train men from the different collieries, and then you would have at the colliery one or more apparatus for use, and you would also have at the colliery a number of trained men ?—I do not think I would have apparatus at the collieries.

18978. Your difficulty is that at the collieries you do not think the apparatus would be kept in proper order ?—I do not think it would be kept in proper order.

18979. I do not quite see why it should not be kept in order at the colliery ?—I do not think it would be.

18980. (*Mr. Wm. Abraham.*) Would it not work in this way now at each colliery : we have men trained for ambulance purposes, first-aid, and so forth ; in this case would not the system be that you would get at least a dozen men trained to use this apparatus, and then you may have one at the colliery if you like, but in order to secure a perfect apparatus you would have one centre which would not be very far off, and then you would have the apparatus from there with a man who understood them, so that he could see that they were placed properly upon the men ?—I think the point is this, that if you have the apparatus at the station, the man there who is competent and who knows all about them can have them under his eye in rotation, so that every apparatus is inspected. Supposing the station is for a group of half-a-dozen collieries, and there are 20 apparatus kept there, that is four sets of five, each apparatus would come under his notice in rotation. If you have the apparatus at the colliery there would be no objection to that, but I say they must come to this station at very short intervals, so that the expert should have them under his notice, or otherwise they would not be fit to use.

18981. (*Chairman.*) That is a matter of detail, is it not ? —It is a very important detail.

18982. (*Sir Lindsay Wood.*) I should have thought it would depend upon the colliery : if a manager at a colliery has a man to keep his apparatus in proper order, I should think that would be sufficient?—I do not think it would be sufficient.

(*Mr. Cunynghame.*) At a very large colliery you might do it.

18983-4. (*Chairman.*) You say it is largely in Germany that the development of this apparatus has been brought about, and you think that the German Government have recognised the desirability of maintaining an attitude of caution in the matter, inasmuch as they have not yet seen their way to suggest any compulsory measures in regard to rescue apparatus ?—Yes.

18985-88. Do you know at all how largely these apparatus are used in Germany ?—Yes ; the Germans in Westphalia have several large stations and also at some of the large collieries one or two sets of apparatus are kept : but they look upon it very largely from the point of view of saving property in cases of underground fires, and gob fires, and there have been numbers of cases where the apparatus has been of great use in saving property in underground fires.

18989-97. So that your experience is that in Germany this system of apparatus is rapidly coming into favour ?—Yes, I think so. I was reading the evidence given before this Commission some little time ago, and I saw that you had one of the inspectors before you, I think it was Mr. Gray, who asked what could be done when men were found 1,000 yards in-bye, to get them out through a body of fire-damp. Of course we have not tried it in this country at all, but there is one idea in connection with that which I should like to put before you, that is the Pneumatogen in its lighter form—the No. 1 Pneumatogen, I think it is. It only weighs about 4 lbs. altogether and it is sufficient to provide enough oxygen to keep a man alive for three-quarters of an hour, and if a rescue party had reason to believe that they could find men some distance in-bye, they might very easily carry one or two of these Pneumatogens and put them on to any man they might find and help him out with it. I think that is to a certain extent an answer to Mr. Gray's question.

18998. (*Chairman.*) But you do not know whether that has ever been done—whether any man has gone into a mine equipped with sets of apparatus to assist other men to get out ?—No ; but the Pneumatogen has been experimented upon very largely at the Bochum School of Mines.

18999. Yes, I understand it has been experimented upon, but it has not been used underground for the purpose of bringing out people ?—No.

19000. I understand the pneumatogen does not have any reservoir ?—No ; the chemicals which are used produce the oxygen as well as absorb the carbon dioxide.

19001. You do not know of your own knowledge whether anybody has ever gone into a mine not only equipped as regards himself but having in his possession some sort of apparatus which can be put upon another man in order to bring him out ?—No, I do not know whether that has been done. I merely suggest this as a possible use to meet this difficulty I was going to say that at Bochum the feeling, which is the result of very recent experiment, is that this apparatus—the Pneumatogen—gives rise to a good deal of vomiting and it is for that reason not as satisfactory as it was hoped it would be.

Digitized by Google

19002. But not dangerous vomiting, I suppose; a man could be got out and although he might be uncomfortable still he would be alive?—I do not think it is dangerous, but there is some chemical action taking place which gives rise to great heat, and I think they have found that this is rather troublesome—more troublesome than they thought before.

19003. (*Dr. Haldane.*) Have you tried the Pneumatogen?—Yes, we have one.

19004. But did you not find that it got blocked after a little time?—We have not had sufficient experience of it to say that, but the heat which it gives off is intense; you cannot bear your hand upon the apparatus because it is so hot.

19005. But it is quite comfortable to breathe?—Yes.

19006. The dry heat does not do you any harm?—Our reason for not trying it more was chiefly on account of the expense.

19007. But it is no dearer than the others?—Yes, it is much more expensive.

19008. The apparatus is not?—No, not the apparatus, but the alkali is so expensive.

19009. (*Mr. Cunynghame.*) Supposing there was an accident at a mine and there was a number of people about the pit-head and a rescue party was being fitted up, I suppose it would be of immense importance to have what I may call a "dresser" before people went down who could see that the apparatus was in perfect order, exactly in the same way as they do in the case of a diver where he is putting on the apparatus, when the most important thing is to have somebody present who is responsible, and not to allow anybody to go into the water without knowing that the apparatus is in perfect order?—Yes. If you have a joint station and a number of apparatus there, and something happens at the colliery, you telephone to that station.

19010. That is what I am dealing with; it is met by that?—The caretaker from the station comes himself with the apparatus, and no man would be allowed to go down the pit unless he has had the apparatus fitted on by this man, and unless he says it is right the man should not be allowed to go.

19011. Then it seems to me that a very big colliery would probably have an expert who was quite to be trusted to send men down with the apparatus; but I should have thought that with a large number of small collieries it might be difficult to secure a sufficiently good man at each colliery to be trusted with the responsibility, in the confusion which takes place upon an accident, of sending down the men, and therefore it would be better to have a man from a central station. That is my own view about it?—I quite agree with you.

19012. There is another point. I should have thought it would be rather more economical and that you might have a certain number of apparatus at the collieries for those who liked to keep them, but that if you had a splendidly-equipped station with perfect apparatus to cope with the necessity for them, from the point of view of efficiency and economy also you would get a better system?—I quite agree with that. I do not like the idea of keeping them at the colliery. I think they would get out of order.

19013. I should like to go further and it seems to me that if you had central stations subscribed to and kept open by the different collieries, any work that our inspectors could do of inspecting and from time to time seeing that the apparatus were in perfect order would be very much easier, and it would be easier to inspect that one place than to inspect a very large number?—Yes.

19014. Now one further point; it is plain that in a rescue party the men who go down the mine must, at all events a great many of them, be familiar with the mine, and they must be men from that particular mine who know the way?—You must have someone who knows the way.

19015. Am I right in supposing that a certain number of the men who go down a mine on the occasion of an accident will be men selected from a neighbouring mine on account of their extreme skill in the use of these apparatus, or even men from a central station?—Yes.

19016. Provided always that you have a certain number of men from the mine capable of guiding the party and men who know the mine and who would be sufficiently acquainted with the apparatus so as not to make it unsafe for them to go down?—I agree with your view. I think that if you have a number of collieries who support a joint station, those would send men at intervals to be trained, and after those men become trained it would be necessary for them to go only occasionally for practice. Then in course of time they get say 40 or 30 men at a colliery who are all trained; then in case of a disaster happening those men would not only be able to go down their own pit, but could help another party at an adjacent mine, assuming that there is always somebody there who knows the mine to go with them. That is what you mean?

19017. I should ask you whether you agree with this, that after all it is better to have a smaller number of men who are thoroughly efficient than to attempt to have a very large number of men who are rather inefficient?—Yes, I quite agree with you; and I go further than that; it is a thing as to which you must have them thoroughly trained or not at all—you cannot half do it; they must be thoroughly trained.

19018. I suppose you have heard that a man was killed at the Courrières mine in trying on one of these apparatus, not understanding it?—Yes.

19019. (*Sir Lindsay Wood.*) Take this illustration; you think it would be necessary perhaps to have 50 or 100 sets?—No, I do not think it is necessary to have that number; I think 20 sets of apparatus is a very fair nucleus for a station, if they are always in order. You would not have perhaps only one station as a large one; you would have a number of stations.

19020. Take a group of collieries within a radius of 5 miles?—We have four colliery companies joining together in one station, and I consider that if we get 20 sets we shall be quite sufficiently equipped for those four collieries.

19021. How many would it take to keep 20 sets in order?—Do you mean at the station?

19022. Yes.—One man whose whole time is occupied at the station would maintain 20 sets in an efficient condition with the aid of an assistant. He would require assistance in charging them for practice purposes.

19023. Where would that station be; would it be under the charge of one particular colliery, or would it be situated entirely by itself?—I think perhaps I had better explain what we do in the case of the Tankersley station; we have four companies interested in this station, and it is managed by a Committee of Trustees. Each Company appoints a Trustee, and those Trustees have the whole management of this station, and they engage the caretaker. Each company subscribes so much per annum to the support of this station, and they defray all the expenses of this station; the only expense which is not defrayed by this Committee of Trustees is any expense appertaining to the men attending for practice. You cannot send a man to take part in a smoke test, when he gets himself into a great state of perspiration and very dirty, and when he may have to go several miles, without paying him for it. That payment must be made by the individual colliery. But with that exception the cost of all the stores, oxygen, alkali, man's salary, rates, and so forth, is all paid by the Committee of Trustees.

19024. The Committee of four?—Yes—one for each colliery.

19025. They would be responsible for looking after the man in charge?—Yes; he is their servant.

19026. I want to know who is to be responsible for seeing that that man does his duty?—He is the servant of this Board of Trustees, and in the case of any accident happening at any colliery they would telephone to the station, and he would go to the particular colliery that he is sent for to go to; he would not go to another colliery which was not in the group.

19027. But there must be somebody to look after that man, and I understand that is done by the Board of Trustees, and they pay him his wages?—Yes.

19028. Would that one man be sufficient to teach the other men who go from the different collieries?—Yes, to train them. Each Company has a certain night in the week when they can send their men, and we find now that once a fortnight is sufficient.

19029. That is to say for the men coming from each colliery?—Yes.

19030. They would not all come the same night, of course?—No: we do not have more than four men at once: that is on account of the expense, because the expense is very great. If you have two hours' test with 5 men with the "Draeger" apparatus it will cost the station between 30*s.* and £2 every evening. I think it is nearly £2: you have to pay for the oxygen, the alkali, and the carriage of the oxygen cylinders to and from Manchester.

19031. Then those men after they are trained, will be

Digitized by Google

Mr. M. H. Habershon.

1 May, 1907.

men capable of exploring any mine with this apparatus on them ?—Yes ; and the manager of each colliery would have a list sent to him from the station say every three months or six months, of the names of the men belonging to his pit who are trained : each individual manager of the collieries in the group would have such a list, so that he would know then how many men he had who were trained : and it would be to his interest then to see that those men were not all employed on the same shift, so that they would not be all in the pit together.

19032. But the manager would be the man who sent the men to the station to use the apparatus ?—Yes, but he does not know if they are competent : that is a matter for the other man to see to.

19033. He would have to have a certificate of competency, but he would know what men he sent there ?—Yes, but he would not know whether they have actually been through the practice, and which men were competent. Periodically he would know from the certificate of the man at the station who were competent. After a man had been trained with the "Draeger" Helmet apparatus he would not have to attend for practice except very rarely to keep up his efficiency ; but with the mouth-breathing apparatus we find it takes much longer to train a man, and he does not maintain his efficiency so easily as with the helmet.

19034. Then in the case of explosion these men would be able really to fit on the apparatus one to the other ?—At present I do not think they are sufficiently skilled to do so. That is very desirable, but I do not think it has been done at present.

19035. As soon as they are trained ?—No, it takes longer than that.

19036. Why should they not be trained equally with the man who supervises the apparatus ?—Because to know that an apparatus is thoroughly reliable needs knowledge of the construction of the apparatus, which implies more technical knowledge than an ordinary deputy in a pit would have. The injector and the oxygen governing valve are of complicated construction, and whereas a thoroughly competent man at the station might know what was wrong and be able to put it right, a well-trained man simply wearing the apparatus would have no knowledge at all of what was the matter, and he would not acquire it easily unless he set himself to go through a special training to acquire that knowledge. Therefore it is essential that on each occasion when the things are put on for real rescue purposes the man who is competent must put the apparatus on to the other man and say, "Now that is all right, and you can go."

19037. I take it the apparatus is in perfect order when it leaves the central station ?—Yes.

19038. It gets to the man in perfect order ; then cannot another man put it on ?—No, I should not like to take the responsibility. I think you must have a man there who knows all about it, and you should ask him, "Are these men all right ; have you tested all these ?" and he should be able to say "Yes" ; then I should feel confident that the men were in a proper condition to go down.

19039. Have these apparatus to go back to the station to be charged ?—No, not necessarily. You can put spare cylinders in. The cylinders are things which should be kept ready : if you have 20 sets at the station you want two spare cylinders for each.

19040. Those should be always ready ?—Always ready and charged. Supposing you sent a party of five men down a pit with the apparatus on, and they came back in two hours' time, with the "Draeger" you can use the same apparatus by simply putting in new alkali cartridges and fresh cylinders of oxygen.

19041. But in the case of explosion you would require more than one trained man to put on the apparatus : it might have to go on for a week every few hours ?—Yes, you would, of course ; but supposing there was another station a number of miles away belonging to another group of collieries, you would wire to them, saying, "We have had a catastrophe here ; can you send over your man to help us ?" Of course, men do not exist in this country with sufficient knowledge of the apparatus at present.

19042. They would have to be taught ?—Yes, they would have to be taught.

19043. It does not take long to teach a man ?—I think if a man were to attend at a station with the object in view of being trained, in about a dozen visits he would obtain sufficient knowledge. It is a thing which cannot be learned in a very short time : it requires special training. There is another point which I have not mentioned, that is the question of medical examination. All men are not suitable constitutionally to wear an apparatus of this kind, and it may be desirable that there should be some medical test as to the soundness of the heart and lungs.

19044. That would have to be done by the Manager of the colliery before he sent the men to learn—I mean to say not done by himself, but done by his doctor ?—Yes. It is a point whichh as not been mentioned yet anywhere, but it occurred to me that it was necessary to consider it.

19045. It should be done ?—Yes.

19046. (*Mr. Ratcliffe Ellis.*) Have you a sketch of your station with you ?—Yes.*

19047. You have not a gallery there ?—No, we have simply a practice chamber. But I think you cannot train men as they ought to be trained w.thou. having some gallery.

19048. You have not a gallery representing the conditions of an underground roadway ?—No ; that is simply a practice room which we fill with noxious atmosphere.

19049. Mr. Garforth has a gallery in which the conditions are just as they would be down a pit ?—Yes, I am aware of that. I have a tracing here of a model station for a number of collieries which embodies what I think is required. (*The witness produced tracing, which he explained to the Commissioners.*)† That station as it is there—the building—would cost £1,700 ; that includes the whole of the brickwork, the drainage, the water supply, the baths, the gas, and all that kind of thing ; but it does not include any special fittings, like a fan, for furnace, or air pipes—it is simply the building itself. The internal fitting of the gallery would be extra.

19050. (*Mr. Ratcliffe Ellis.*) Then you have also the land to pay for ?—Yes.

19051. (*Chairman.*) I should have thought it was very cheap for a big building of that sort ?—These are the architect's figures.

19052. (*Mr. Ratcliffe Ellis.*) You have assumed that one man would be the caretaker ?—Yes.

19053. Then what is the annual upkeep ?—That depends upon the amount of work you are doing. If you are going to have five men and give them two hours training I estimate it would cost you £2 for each evening, and then you would have to pay the salary of your caretaker ; but the £2 covers the cost of oxygen and alkali, and the carriage from Manchester.

19054. I suppose that this apparatus in skilled hands might be of very great use in saving life ?—Yes, I think so, in skilled hands.

19055. In unskilled hands it is a very dangerous thing ?—It might be a death trap. That is the point which I should like to impress upon the Commission—that it requires very great caution in dealing with at the present moment for that reason.

19056. You think that for the present it is desirable that there should be stations established in different districts for the purpose of ascertaining by experiment which apparatus they like the best ?—Yes.

19057. And, secondly, for the purpose of training people in the use of the apparatus ?—Yes.

19058. That is the object of the station ?—Yes. I think it should be voluntary work at present, because the thing is so recent and the knowledge of it is so limited in this country.

19059. You seem to favour this "Draeger" machine. Is it not very heavy ?—The "Draeger" apparatus weighs 28 lbs., and the helmet weighs about 3 lbs. more ; that is about 31 lbs. or so ; the "Weg" weighs 30 lbs.

19060. I think you will find that the "Draeger" weighs between 36 and 39 lbs ?—The difference is between the different sizes. I think I can explain that : the "Draeger" is made in three sizes to fit three different sizes of heads, and there is a little difference in the weight of those different sizes, and the least heavy is 28 lbs.

19061. Then is not the "Draeger" very heavy, and, owing in part to its being badly slung, is it not very uncomfortable to work in ?—Our men have not found it so. At Altofts they have gone through a 2-ft. pipe with it on, and they have dragged a man through a 2-ft. pipe and moved a lot of stones and come out perfectly fresh after

* Plate XX. † Plate XXI.

Digitized by Google

PLAN OF THE RESCUE STATION AT TANKERSLEY

SCALE, 16 FEET TO 1 INCH.

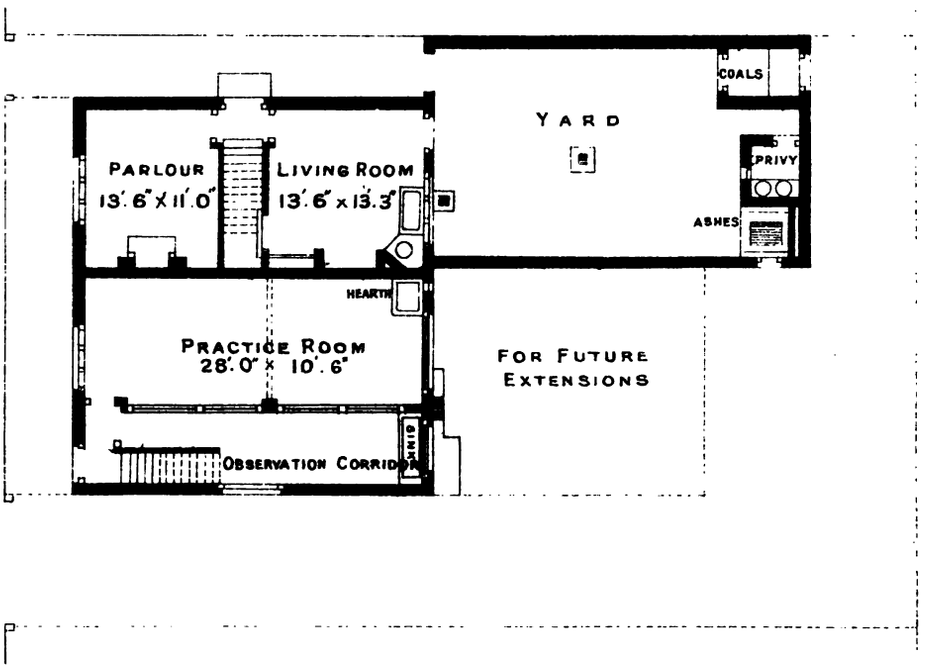


FIG 1.—GROUND PLAN.

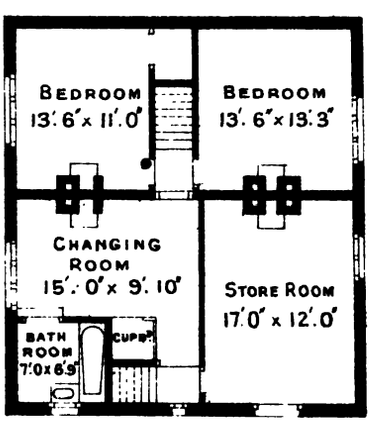


FIG. 2.—CHAMBER PLAN.

Weller & Graham, Ltd Litho. London.

Digitized by Google

Digitized by Google

Mr. M. H. Habershon.

1 May, 1907.

Digitized by Google

Digitized by Google

doing all that, for the number of hours which I have stated.

19062. You have not made any test of the "Weg" apparatus —Unfortunately I cannot get hold of that: It is Mr. Garforth's, and as yet he has not got two of them alike; it is in a state of development.

19063. The comfort and convenience of the "Draeger" is not very great, is it?—Well, I think it is a comfortable apparatus.

19064. You think it is so important that the apparatus should be kept in good order that they should be kept at this station?—I am inclined to think so. I think there is a danger in allowing them to be at collieries: if they were to be at collieries they must be taken away from that colliery to a man who can examine them at intervals, and I think it is much more easy for him to have the apparatus at a station than to go round to collieries.

19065. Your view is that it is so essential that the apparatus should be kept in good order that at present, at any rate, you think they should be kept at stations and not at collieries?—Yes, I think so.

19066. Then again, you think it is very important that when they have to be put on, a man should go from the station to the colliery to put them on?—I think so.

19067-69. Do you not think that when a man at a colliery has been trained he is competent enough to put the apparatus on another man?—A very exceptional man might be; you might find a man here and there who could do that but not as a rule. Many men whom you would want to take part in rescue work would not be competent to put an apparatus on so as to say whether it was right or not.

19070. (*Dr. Haldane.*) Did you ever make experiments with some of the older types of apparatus?—We started with the "Shamrock" in 1901, which Herr Meyer showed us at Dusseldorf. I saw a demonstration in his gallery with that. We sent over the man whom we have as caretaker to be trained at Shamrock, and he came back and told us what fearful headaches the Germans got in trying to master that apparatus, and we found that to be our experience. A little thing going wrong with it will cause an immense difference.

19071. Did you ever try the "Fleuss" apparatus?—No. We did not begin until 1901.

19072. There is one of that make that is sold, and even with its imperfections it absorbed the carbonic acid extraordinarily well: I was very much astonished at it. You have not tried their new English apparatus—that is to say, the new modified "Fleuss"?—No, we have not tried that.

19073. That is well worth trying. Have you tried any experiments with the liquid air apparatus?—No. I do not know anything at all about it, only what I have seen in the transactions of the Institute.

19074. You spoke about duration experiments and said that with the "Draeger" apparatus a man breathed through it for six hours, I think. Is that so?—No, for five hours—Mr. Garforth has had a man in the "Weg" apparatus for six hours.

19075. The "Draeger" apparatus which I have seen is set to run at a certain rate so that it would not last more than about two hours. Is that a new form?—No, the "Draeger" apparatus, as you know, is arranged both for helmet and for mouth-breathing. If you want to do hard work a man in a helmet can use both his mouth and his nose for breathing, and he could do very much harder work with that than any other apparatus I have come across. But if he is going to economise the oxygen he is better off then with the mouth-breathing type, because he has two bags, and he can by regulating his valves conserve his supply of oxygen. In the case of a gob fire you might want to send a man down a pit and you might say to him, "Stop here and watch this point until somebody comes to relieve you," and a man might have to be there for several hours. In the "Draeger" mouth-breathing type, if he was a perfectly trained man he could stop there for five hours, and the only result would be that he would be hungry and he would not have anything else happen to him.

19076. That is to say he can turn off the oxygen supply —he has two rates at which the oxygen comes into the bag?—It is not a question of two rates but he has two cylinders, and can regulate the oxygen supply.

19077. But the oxygen must all the time be coming in at a definite rate, whether it is fast or slow, otherwise the man would be in danger of being asphixiated at any moment?—That is the difference between Mr. Garforth's apparatus and the "Draeger." His apparatus is a variable feed apparatus and the "Draeger" is a constant feed as regards the oxygen: the "Draeger" is arranged to give a supply of oxygen at the rate of two litres a minute and it must come through the mouth-breathing valve. If he has those two little bags he can conserve that to a certain extent and make it last longer.

19078. Then he is not getting two litres a minute?—No, but he is lotting it into the bags as he requires it.

19079. Then it cannot be coming out?—It is coming out of the cylinder intermittently.

19080. But if it is coming out at the rate of two litres a minute, it would burst the bag in three or four minutes. Do you not think it is rather dangerous?—It is a test which we made to see what could be done in a special case.

19081. The apparatus is not meant for that?—No.

19082. I should have thought it would be rather dangerous to do that in a mine?—Yes, but if you wish to leave a man in a position, as I have said just now to do a certain thing and not move, it is different.

19083. You mean in fresh air?—No, I mean in case of underground fire, where you want a man to stop at a certain place; I say he can stay there three or four hours with the mouth-breathing "Draeger" if he has been trained to do it.

19084. That makes it work exactly like the old "Fleuss" apparatus?—Yes.

19085. I must say I should have thought that was rather dangerous, and I should say this again is rather dangerous also?—It would not be safe for a man who was not thoroughly skilled.

19086. The advantage of the "Weg" apparatus is that that is done automatically for you, is it not; with the "Weg" apparatus the oxygen does last?—But it has to be controlled by the man manipulating his valves in the "Weg" apparatus. To my mind the beauty of the "Draeger" is that the man need not bother about his valves at all; he gets a constant supply of 2 litres per minute, but with the "Weg" he does not get a constant supply—he has to look after himself.

19087. But his oxygen will last much longer with the "Weg"; he does not throw it away?—But I would not let a man stop more than two hours; I think that should be the limit, and I think two hours is long enough.

19088. Perhaps it is, but that is another point. I mean he has to carry a bigger weight of cylinder in order to have enough oxygen?—But Mr. Garforth's apparatus weighs as heavy as the "Draeger"; there is not 2 lbs. difference between them. I think the "Draeger" with the mouth breathing arrangement is lighter by 2 lbs. than Mr. Garforth's.

19089. I have not seen that one, but I thought the "Weg" apparatus was a good deal lighter?—No, it weighs 30 lbs., and the "Draeger" mouthpiece type weighs 28 lbs. The "Draeger" helmet weighs more than that by some few pounds in the different shaped helmets. One man was very anxious indeed to master the "Draeger," but we could not get a helmet big enough for him; we have got one now, and that, of course, weighs heavier than the others. Mr. Garforth's apparatus has to be made to fit every individual man, and the "Draeger" Helmet is made in three sizes, and one of those sizes will fit anybody: of course, that is another advantage. I do not wish to "run" the "Draeger" exactly, but I am simply pointing out what we have found to be the difference between the two, and I have had no experience of Mr. Garforth's apparatus —you cannot get one. I have seen it in use at Altofts, and I have discussed it with him, and I simply speak of it from what men who have had both on have told me, and from comparing notes as to the two. Certainly I think it is more complicated.

19090. (*Mr. F. L. Davis.*) Supposing a man feels uncomfortable and thinks the thing is going wrong, can he take it off himself, or does he require a skilled man to take it off?—No, he can release himself immediately.

19091. (*Dr. Haldane.*) That is what a man did at Courrières, and he was found dead, having taken it off?—Yes.

19092. He was in bad air?—He had the helmet on. For exploring in a mine where a man has to go underneath broken timber there is no doubt the mouth-breathing apparatus is the safer of the two, but if you know that a place is all right so far as regards there being plenty of

Digitized by Google

Mr. M. H. Habershon.
1 May 1907.

height to stand in and to walk about in, then I do not see why you should not use the helmet. As I said in the last paper which I have handed in, I think the question of helmet or mouth-breathing type is a matter which must be left for the present to be decided after more experience has been obtained; we cannot dogmatise about it. Herr Meyer has taken this up in reply in discussion, and he says he will not have the helmet.

19093. There is one point with regard to the helmet which I was wondering whether you have considered, that is as to the temperature of a mine as compared with the atmosphere of the experimental chamber. When a thing like that is used it is very probable that it is used at a gob fire, or some place that is equally hot, and a helmet, I should have thought, would make a serious difference to a man's power of work?—But he is using both his nose and his mouth, and he can work much more easily than he can with the mouth-breathing type.

19094. I do not think I could do so myself, but I know some people like to use both nose and mouth?—It is natural to use the nose for breathing; if you block up the nose and make a man breath through his mouth, it is artificial.

19095. I know some people are made uncomfortable by it, but it is only a matter of custom, I think?—It is a matter of custom very generally.

TWENTY-NINTH DAY.

Thursday, 2nd May, 1907.

PRESENT:

Lord MONKSWELL (*Chairman*).

Sir LINDSAY WOOD, Bart.
H. H. S. CUNYNGHAME, Esq., C.B.
WM. ABRAHAM, Esq., M.P. (Rhondda).
F. L. DAVIS, Esq.
THOMAS RATCLIFFE ELLIS, Esq.
JOHN SCOTT HALDANE, Esq., F.R.S.
ROBERT SMILLIE, Esq.
S. W. HARRIS, Esq. (*Secretary*).

Mr. DAVID HANNAH, called and examined.

STATEMENT OF WITNESS.

Mr. D. Hannah.
2 May, 1907.

19095A. I am a Mining Engineer, and Agent to Messrs. D. Davis and Sons, Ltd. I have had 35 years' experience in mining and served my time at the Powell Duffryn Collieries, where I was engaged for 7½ years. I was subsequently Surveyor and Under-Manager at the Ocean Collieries for 9½ years, and I have been with Messrs. D. Davis and Sons, Ltd. for 18 years, being employed for the first year as Sub-Agent, and for the past 17 years as Agent to the Ferndale Collieries. I took my first class Managers' certificate in the year 1879. I have been appointed by the Monmouthshire and South Wales Coal Owners' Association to give evidence for Glamorganshire.

(1) It would be difficult to define clearly what is a dusty and what is a non-dusty mine. In some cases no doubt can arise, but the line of demarcation between the two descriptions would be a matter of opinion.

(2) Explosive dust may be found in all parts of a mine.

(3) An explosion may be produced if an accumulation of gas is fired:—

(*a*) By coming into contact with a naked light.

(*b*) By sparks produced by the collision of falling pieces of rock.

(*c*) By sparks caused by rock or ironstone falling on trams or rails.

(*d*) By detonation or great heat given off in firing an explosive.

(4) Under certain peculiar conditions of dust and atmosphere it may be possible to produce an explosion by the flame of a naked light, where fire damp is not present, or where there is no shot-firing.

(5) In any case, an explosion would be much intensified by the presence of coal dust, or by strong currents of fresh air.

(6) The purest and finest coal dust is the most explosive, and it becomes less explosive in proportion to the shale and stone dust that may be mixed with it.

(7) The sources of explosive dust are:—

(*a*) From working faces.

(*b*) Blown from the top of trams. (This is the most dangerous form of dust to be found in a mine.)

(*c*) Escaping through trams.

(*d*) From the surface of the pit.

(*a*) *Working face.* Coal dust from this source being of a coarse character, and not subject to the same atmospheric conditions as that of roadways, is comparatively non-dangerous. The coal dust from machine-cut coal is, however, much finer and more dangerous than from hand-cut coal.

(*b & c*) *Trams.* It may be mentioned that the trams for conveying coal, as generally constructed for the Steam Coal Collieries of Glamorganshire, are closely sheeted on two sides, the bottom and one end, and, in my opinion, are not capable of much improvement. It is not practicable to cover them, but the spraying of the loaded trams before they commence to travel on the engine planes is generally adopted in large collieries.

(*d*) *Surface.* Where the screens are close to the downcast shaft, a certain proportion of the dust caused by tipping the coal finds its way into the shaft, but, as most of the pits are wet, the dust is damped to a large extent before it reaches the bottom, and, therefore, is not carried far into the workings. Owing to the narrowness of the Glamorganshire valleys, and the meagreness of surface space available, it is not possible to remove the screens far from the pit's mouth, but the quantity of dust that falls down the pits would be reduced by the adoption of a system of watering at the pit-top.

(8) Location of explosive dust:—

The most dangerous dust will be found: (*a*) On engine planes where the fine dust blown from the journeys of coal travelling at, say, six miles an hour against the ventilating current would be carried away and deposited on the timbers, roof, sides and floor of roadways.

(*b*) On horse haulage roads:—

(1) Where the current of air might not be so strong.

(2) By the dust blown off the coal trams, mixed with that produced by horses and men travelling being deposited on the timbers, roof, sides, and floor of roadways.

Digitized by Google

(9) *Watering.*—In most Glamorganshire collieries there is an ample supply of water.

(10) *Methods of Watering.*—In the steam coal pits of Glamorganshire the system of watering the main roadways (mostly engine planes) by means of pipes is generally adopted. Returns from 17 large companies give a total length of 170 miles of pipes as having been laid for this purpose.* The watering may be done either by spray-jets, or by man and hose.

(*a*) *Spray Jets.*—This system is being superseded by man and hose watering, which is a more efficient system.

(*b*) *Man and Hose.*—This system is in most favour, and is carried out in the following manner. Along the main column of pipes, stand-pipes are arranged about 40 yards apart. A workman carries a hose of 20 yards in length, which he attaches to the stand-pipes successively and waters 20 yards on each side. By this method the roadways are judiciously and efficiently watered. This is usually done once a day, and, by experience, the man gets to know the quantity of water necessary for the purpose, and its effect upon the roof and sides.

(*c*) *Tanks and Casks.*—In addition to pipe watering, iron tanks and casks in trams—drawn by horses—are used on in-bye roadways for watering the floors and in connection with shot-firing.

(11) *Watered Zones.*—Where the roof and sides do not permit of watering by the above methods, zone watering might be tried. Watered zones might have the effect of stopping or diminishing the force of an explosion. They should be arched with bricks or stone, and be kept constantly wet by means of sprays. The length of the zone would be determined by its position. If it be situated on the main arteries of a colliery, where the currents of air be strong, it would be of greater length than if placed on bye-ways, where the current of air might be of low velocity. 50 to 100 yards would be a reasonable length of zone.

(12) *Removal of dust by brushing.*—It would be difficult to adopt this method effectually, as the timbers, roofs, and sides of a roadway do not afford a sufficiently smooth surface for the purpose. When the dust was brushed from one spot it would settle on another, and to remove the dust out of a whole colliery by this means would not be at all practicable.

(13) The floors of the roadways are periodically cleaned and the dust and rubbish either sent to the surface or stowed underground.

(14) *Cost of watering.*—Without having regard to the effect on roof, sides and floor, the watering will cost about one penny per ton on the output. The increased cost of repairs and pitwood, as a result of watering, is estimated at fivepence per ton, so that the inclusive cost would be about sixpence per ton.

(15) *General remarks.*—Where the roof and sides permit, general watering is preferable to partial or zone watering. The effect of watering the shale-roof and sides in most of the seams in Glamorganshire is to pulverise the ground. This causes the roadway to close in, requiring more frequent re-opening or enlarging. The watering is a frequent cause of falls of roof; these falls are often of considerable height, forming large cavities in the roof. Even in good roofs, the moisture gets into the cleavages and joints, lessens cohesion and produces a greater tendency to falls. The watering of the floors (which are general fire-clay) causes heaving, which sometimes continues until the roadways have been raised considerably above their original level; in many instances from 6 to 10 feet. To pave the floors of Glamorganshire collieries with bricks would be useless, as they would be constantly heaved out of position. On steep roadways, where the haulage is done by horses, watering the roadways makes the rails greasy, and the heavy trams—even when fully spragged—often overpower the horse, causing danger to both man and horse.

(16) I am of opinion that watering is the most effective method of dealing with the dust in collieries.

FERNDALE COLLIERIES.

Length of Roads on which Coal is Hauled.

Roads used simply for airways or travelling roads not taken into account.

No. of Pit.	Length of Roads.		Stall.	Total.	Total Length of Pipes Laid.
	Mechanical Haulage.	Horse Haulage.			
	Yards.	Yards.	Yards.	Yards.	Yards.
1	7,240	10,255	7,350	24,845	5,530
2	3,990	4,580	3,240	11,810	5,046
3	4,310	6,760	3,160	14,230	6,695
4	4,200	4,425	2,750	11,375	2,475
5	6,600	7,965	5,610	20,175	7,890
6	4,100	1,470	2,000	7,570	3,580
7	6,950	11,400	5,650	24,000	6,343
8	8,079	6,930	3,970	18,979	10,230
	45,469	53,785	33,730	132,984	47,789
Miles	26 (nearly)	30½	19	75½	27

FERNDALE COLLIERIES.

Annual Cost of Watering, Maintenance of Watering and Extension.

No. of Pit.	Total Cost of Installation.	Depreciation. 20 per cent. on Pipes. 50 per cent. on Fittings.	Extension (Estimate).	No. of Men at Present Engaged in Watering.	Rate of Men, 4s. 6d. per Day Gross.	Total for Pipe Watering.	Annual Amount Expended on Tank Watering (Estimated).	Total Expense of Watering.
	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.	£ s. d.
1	527 11 8	99 1 10	60 0 0	6	405 0 0	564 1 10	380 0 0	944 1 10
2	375 15 9	73 0 8	50 0 0	4	270 0 0	393 0 8	100 0 0	493 0 8
3	440 16 10	84 16 1	40 0 0	3	202 10 0	327 6 1	100 0 0	427 6 1
4	157 19 6	31 19 3	40 0 0	3	202 10 0	274 9 3	200 0 0	474 9 3
5	587 1 11	109 6 0	80 0 0	6	405 0 0	594 6 0	50 0 0	644 6 0
6	281 15 8	54 10 9	50 0 0	2	135 0 0	239 10 9	225 0 0	464 10 9
7	480 8 2	95 0 9	100 0 0	6	405 0 0	600 0 9	300 0 0	900 0 9
8	689 18 5	129 5 7	100 0 0	7	472 10 0	701 15 7	—	701 15 7
	£3,541 7 11	£677 0 11	£520 0 0	37	£2,497 10 0	£3,694 10 11	£1,355 0 0	£5,049 10 11

* See Appendix I.

Digitized by Google

Mr. D. Hannah.

2 May, 1907.

FERNDALE COLLIERIES.

Cost of Water Pipe Installation.

No. of Pit.	Water Pipes. Length in Yards.	Size.	Price per Yard.		Fittings for Spray and Hose.	Total Cost of Material.	Laying Pipes and Fittings (Estimated).	Total Cost of Material and Labour.
			s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1	1,980	1 in.	10·2	84 3 0	10 16 8		24 15 0	
	1,650	1½ in.	1 6	123 15 0	10 7 10		20 12 6	
	1,900	2 in.	2 1·2	199 10 0	14 0 0		39 11 8	
	5,530					442 12 6		527 11 8
2	4,025	1 in.	—	171 1 3	29 5 8		50 6 3	
	335	1½ in.	—	25 2 6	2 15 9		4 3 9	
	686	2 in.	—	72 0 7	6 14 2		14 5 10	
	5,046					306 19 11		375 15 9
3	6,328	1 in.	—	268 18 9	43 14 2		79 2 0	
	367	2 in.	—	38 10 8	2 18 4		7 12 11	
	6,695					354 1 11		440 16 10
4	2,475	1 in.	—	105 3 9	21 17 0		30 18 9	
						127 0 9		157 19 6
5	6,110	1 in.	—	259 13 6	33 9 5		76 7 6	
	490	1½ in.	—	36 15 0	3 0 10		6 2 6	
	1,290	2 in.	—	135 9 0	9 6 8		26 17 6	
	7,890					477 14 5		587 1 11
6	2,780	1 in.	—	118 3 0	20 6 10		34 15 0	
	800	2 in.	—	84 0 0	7 17 6		16 13 4	
	3,580					230 7 4		281 15 8
7	4,075	1 in.	—	173 3 9	31 9 0		50 18 9	
	168	1½ in.	1 2·4	10 1 7	1 4 8		2 2 0	
	1,850	1½ in.	—	138 15 0	15 16 3		23 2 6	
	250	2 in.	—	26 5 0	2 5 6		5 4 2	
	6,343					399 0 9		480 8 2
8	9,300	1 in.	—	395 5 0	54 13 9		116 5 0	
	930	2 in.	—	97 13 0	6 14 2		19 7 6	
	10,230					554 5 11		689 18 5
	47,789 or 27 Miles ...			£2,563 9 4	£328 14 2	£2,892 3 6	£649 4 5	£3,541 7 11

Average cost per 1,000 yards of Pipes and Fittings, complete, £74 2s.

FERNDALE COLLIERIES.

Analyses of Coal Dust.

No. of Sample.	Description of Sample.	Composition. Ash.	Volatile.	Fixed Carbon.	Moisture.
1. Six Feet Seam ...	Mechanical haulage, floor dust screened through lamp gauze	14·71	14·28	69·46	1·55
1A. „ „ ...	Mechanical haulage, floor dust, as found	—	—	—	—
2. „ „ ...	Horse haulage, floor dust, screened	20·72	14·09	64·28	·91
2A. „ „ ...	Horse haulage, floor dust, as found	—	—	—	—
3. „ „ ...	Face dust, screened	3·74	13·70	81·76	·80
3A. „ „ ...	Face dust, as found	—	—	—	—
4. „ „ ...	Mechanical haulage, roof and sides, screened ...	9·96	14·30	74·71	1·03
5. Four Feet Seam	Mechanical haulage, roof and sides, screened ...	25·41	15·60	57·93	1·06
6. „ „ ...	Mechanical haulage, floor, screened	24·75	14·55	59·59	1·11
6A. „ „ ...	Mechanical haulage, floor, as found	—	—	—	—
7. „ „ ...	Horse haulage, floor, screened	36·23	14·37	48·27	1·13
7A. „ „ ...	Horse haulage, floor, as found	—	—	—	—
8. „ „ ...	Face dust	17·52	13·50	68·32	·66
9.	Screen dust, screened	10·51	13·17	75·16	1·16
10. Yard Seam ...	Face dust, machine cut, screened	1·56	13·05	82·68	2·71
11. Six Feet Seam ...	Return airway: no coal hauled, screened	22·23	12·17	63·74	1·86

Digitized by Google

19096. You are a mining engineer and agent to Messrs. D. Davis & Sons, Limited ?—Yes.

19097. Have you had 35 years' experience ?—Yes.

19098. You took your first-class Manager's certificate in the year 1879, and you have been appointed by the Monmouthshire and South Wales Coal Owners' Association to give evidence for Glamorganshire ?—Yes.

19099. Have you had any experience of mining outside Wales ?—Not outside Wales.

19100. You first of all go into the question of coal dust, and you say that it would be difficult to define clearly what is meant by a dusty or non-dusty mine. Have you any suggestion to make as to a definition ?—I have no suggestion to make. It is very difficult to define when it changes from one to the other.

19101. Have you any idea what amount of dry dust in a mine would be dangerous ?—I have not.

19102. It has been suggested to us that a very thick cloud of coal dust raised by an explosion would be less inflammable than a thinner cloud of dust. The theory, I understand is that only a certain portion of the dust mixes with the oxygen, and explodes, and the remainder of the dust acts somewhat in the way of smothering an explosion. I do not know whether you have any experience of that ?—I should not think that would be so.

19103. So far as your experience goes, it is not so ?—The thicker the cloud of dust the more dangerous, in my opinion.

19104. And the further it would be carried on ?—Yes.

19105. I suppose you only say that, not from any detailed experience, but as a sort of general idea ?—That is my opinion.

19106. You have not thought the question out, I suppose ?—Well, that is my opinion.

19107. Perhaps you have not had your attention called to that theory ?—Not to that theory.

19108. You say explosive dust may be found in all parts of a mine. I suppose in some parts of a mine it would be more explosive than in others ?—Yes.

19109. Where do you say the most dangerous part of the mine would be as regards coal dust ?—First of all on the engine planes.

19110. On the haulage roads ?—More particularly in the engine planes with mechanical haulage than on horse haulage roads.

19111. Next, the horse haulage roads ?—Yes.

19112. Do you think on a horse haulage road the dust would be more explosive than in travelling roads for men where the horses did not go ? It has been suggested by some witnesses that horses kick up a lot of shale in the roadways, and that that mixes with the coal dust and renders it less explosive than it otherwise would be ?—All our travelling ways to the faces are horse haulages.

19113. Do you think that the dust on the horse haulage roads is as explosive as the dust, we will say, on the roof and sides of any approach, or the faces ?—They would be all horse haulage roadways. Of course the distinction is between engine planes and horse haulage roadways.

19114. There are no roads where only men can go along in your mine ?—There are none for coal-getting.

19115. The effect of using horses, I suppose, is to mix a certain amount of shale with the coal dust ?—That is so.

19116. And that renders it less explosive ?—Yes.

19117. It is on the ground ?—On the ground ; and what is kicked into the air gets deposited on the roof and sides.

19118. And that is not pure coal dust, but it would be mixed with shale ?—Yes, mixed with shale.

19119. Therefore not so explosive as on the engine planes ?—That is so.

19120. Then you say there are various reasons for causing an explosion, for instance, if there was an accumulation of gas by coming into contact with a naked light—by sparks produced by a collision of falling pieces of rock—by sparks caused by rock or ironstone falling on trams or rails—and by detonation or great heat given off in firing the explosive ?—That is so.

19121. Then you go on to say that under certain peculiar conditions of dust and atmosphere it may be possible to produce an explosion by the flame of a naked light, where fire-damp is not present, or where there is no shot-firing. Have you had any experience of that ?—I have not, except what I have read of certain collieries where that has taken place.

19122. You have no instance you can verify in South Wales of that happening ?—No.

19123. In every case where there has been an explosion, there has been either fire-damp, or if not fire-damp, the explosion has been caused by a blown-out shot, or something other than a mere flame of light ?—That is so.

19124. (*Mr. Wm. Abraham.*) But there has been a case in South Wales where no one knows what was the cause of firing ?—The Chairman asked with regard to a flame or naked light starting an explosion from coal dust alone. I think there are instances where falling ground has produced a spark which has produced an explosion.

19125. (*Chairman.*) Without any gas at all ?—I could not say.

19126. That would be extremely difficult to tell ?—Yes.

19127. Where you have falling ground in a very fiery mine, the probability is there may be a little gas released ?—That would be so.

19128. So that you cannot say of your own knowledge there has been any instance where an explosion has been started in the entire absence of gas otherwise than by a blown-out shot, or by some fairly violent explosion ?—No, I cannot say that.

19129. You say that an explosion would be much intensified by the presence of coal dust, or by strong currents of fresh air ?—Yes.

19130. You mean the strong current of fresh air would increase the volume of oxygen, and consequently chemically increase the force of the explosion by reason of there being more oxygen there to combine ?—Yes.

19131. I think we all agree that the purest and the finest coal dust is the most explosive. With regard to the fineness of the coal dust, do you find that there is any great difference in the explosive qualities of very fine coal dust ?—I do not know that I do, but I am strongly of opinion that the finer the coal dust the more explosive it would be.

19132. You say you get explosive dust from the working faces. There is not so much danger of explosion near the working faces, is there, as further away ?—No.

19133. But still there is a certain amount of danger if you fire shots in the working faces ?—There may be a certain amount of danger.

19134. You say the most dangerous form of dust is that blown from the top of trams ?—Yes.

19135. How would you deal with that ?—The way in which we deal with it at present is this—we water the journeys on engine-planes before they start out.

19136. Your coal does not deteriorate from being watered ? There is no objection to watering the coal ?—I think it would deteriorate to a certain extent if it was thickly watered ; but the trams carry a large quantity of coal and the watering they receive is simply on the surface so as to lay the dust on the top of the trams.

19137. Is it watered from time to time as it goes along the engine-plane ?—There is one spray at the start, at the commencement of the journey, and it is not watered more than that once until it gets to the pit bottom.

19138. How long would it be on the journey ?—About five or eight minutes ; it depends upon the distance.

19139. One watering under those circumstances probably is quite sufficient ?—Quite sufficient, I think.

19140. I suppose if you had an enormously long engine plane to deal with, it might be well to water it more than once on the way. However, that is not so in your mine ?—No.

19141. You say another cause of the accumulation of this very dangerous form of coal dust is that sometimes it escapes through the trams. I understand we have here a model of the latest tram ?—Yes.

19142. Do you think it would escape to a dangerous extent through that tram ?—I do not think it would.

19143. How long have you had that tram in use ?—For 10 years.

19144. That is practically the only tram you use ?—We used to have trams that were not so closely sheeted, but during the last 10 or 12 years we have had them closely sheeted in that way, so that we have pretty nearly done away with the trams with the bars, or what are called screen trams.

Digitized by Google

Mr. D. Hannah.

2 May, 1907.

19145. So that although it has been raised 2 feet above the top still very little dust shakes out?—Very little dust shakes out. What there is is generally blown from the top of the tram; there is not much escaping through the bottom.

19146. Notwithstanding that it is only covered on three sides. The fourth side is open with the exception of two bars?—Yes.

19147. You have these bars for the convenience of loading and unloading?—Yes.

19148. It would be very inconvenient if you had all four sides covered?—It would be.

19149. If you had 2 feet above you could hardly cover it on the top?—No.

19150. If you did cover it on the top it would no doubt very much decrease the amount of coal dust deposited on the engine-plane?—With a spray watering I do not think it would make very much difference.

19151. You think the spray watering prevents the dust shaking out from the top?—Yes.

19152. That would depend a good deal, I imagine, upon whether the engine-planes ran smoothly or not?—Yes; the smoother the engine-planes of course the less dust there would be.

19153. That is a matter you look after?—Yes.

19154. And if you find the engine-planes run in a jolty way you attend to that immediately?—Yes. It is to our advantage to get the roads to run as smoothly as possible, because the coal is not so much shaken about and comes out steady on the trams.

19155. You would have to pick up a certain amount of coal which would be deposited on the floor if the roads were bad?—That is so. If the roads were bad there must be some deposited on the floor.

19156. So that it is in every way desirable that the roads should be kept in a very good state of repair?—That is so.

19157. Then you say the dust may escape from the surface of the pit. How near are your screens to the pits?—About 20 yards.

19158. Do you think that is a sufficient distance?—It is very difficult to get them otherwise. The valleys are so very narrow it is difficult to get the screens away from the pit.

19159. So that when you open a new pit it would be difficult to have more than 20 yards?—Yes, very difficult. In our valleys and most of the Glamorganshire valleys it is the same.

19160. As you are obliged to have the screens so close to the pit, are there any means of preventing the dust going down by means of fans which would carry the dust away from the pit mouth?—I think the system of watering on the top of the pit may be adopted, but I do not know whether it would be practicable to have a fan there or not. When the coal is being tipped on to the screens, it might be possible to spray the coal before it is tipped.

19161. Do you do that now?—We do not do it now.

19162. You think it might be done?—It might be done, but there might not be a very high pressure of water on the top of the pits, as there is at the bottom.

19163. Could you introduce sprays on top of the pit, or at any point down the pit?—There might be a system adopted of spraying the tram before it is tipped; but it could not be a continuous spray because the men engaged on the screen in loading the coals from the screens to the trucks of course would get thoroughly wet, if it was a continuous spray. But when the tram was being tipped, if the coal was sprayed with a little water before tipped and then stopped, I think it might be of some use.

19164. Supposing you were to adopt the system of spraying either at the top of the pit or near the bottom of the pit, or any part of the pit, so that any coal dust that went down into the pit would have to go through a spray of water, how would that do?—I may say our shafts are very wet now. I do not think it gets very far in from the pit bottom at present. Owing to the wetness of the pits there is constantly lots of water dropping down the shaft. The shafts are 350 to 400 yards deep.

19165. You do not think there is any or very little deposit of dry dust coming from the bottom of the pit?—There may be a little, not much.

19166. Nearly all your pits are as deep as that which you have given, I suppose?—They vary from 280 yards to 460 yards.

19167. And they are all damp?—Yes, all damp.

19168. You say that the coal dust in the working faces is usually of a coarse character, and not subject to the same atmospheric conditions as that of roadways. You mean there is not so much ventilation, or what?—The coal when being wrought is coarser in quality and not subject to the same atmospheric conditions as the dust back on the engine planes.

19169. What do you mean by atmospheric conditions?—I think when the coal dust has been subjected to the atmosphere it tends to pulverise and oxydise it and make it more dangerous.

19170. You mean the coal dust becomes more dangerous the longer it remains in the mine?—That is my opinion.

19171. The action of the air somehow makes it more liable to become inflammable?—That is what I think.

19172. Independently of its being very fine or not, I suppose. Of course it gets more or less fine. The coarse dust is blown into the rest of the mine by the ventilation from the working faces; and as it is blown into the mine, I suppose it would tend more or less to pulverise and become finer?—Yes.

19173-5. In that way also it would become more inflammable?—Yes.

19176. We should like to have your opinion about machine-cut coal, as there have been various views expressed upon that subject. You say that machine cutting produces much finer dust?—Yes.

19177. That I suppose is certainly so. We have heard, on the other hand, that if you collect the dust at once from the machine and damp it there is no danger. As I understand it, the dust from the coal-cutting machine in some cases is immediately dealt with as it comes from the coal, and is somehow damped or deposited so that it will not do any harm. That is perhaps a rather difficult and delicate process?—I think it is rather difficult to do that. The machine that we use is called the "Pickwick" coal-cutting machine, which has a revolving bar that goes in 5 feet underneath, and cuts it, and the cut is 5 inches thick. The revolving of the bar produces very fine small coal in its process. In the case of hand-cut coal, you simply put the pick into the coal and draw it down; but the machine cuts the coal up into very fine particles.

19178. Could you have any means of watering by taking buckets of water in, and immediately laying it on the dust?—The fine coal dust is at the end underneath the coal about 5 feet in. You could not get at it to do that.

19179. You would have to spread it by means of a pipe?—And you would have to use it under great pressure if you did that.

19180. Is it your opinion that the coal-cutting machines are a source of danger?—I would not say that, but of course the coal dust produced is very much finer in the case of machine-cut coal than in the case of hand-cut coal.

19181. So that you produce in the face much the same thing as you find in the haulage road: you have fine coal dust?—It would not be so fine in the face as it would be on the haulage road.

19182. Not even with the coal-cutter?—No; because what I consider to be the dangerous dust on the engine-plane and horse haulage road is what blows in the air and becomes deposited on the roof and sides.

19183. Would not that dust float in the air?—I do not think it would.

19184. It would not be fine enough for that?—No, it would be too large.

19185. So that it is not so fine as the finest dust?—Not so fine as the finest dust.

19186. Still, it is a good deal finer than the dust which would be naturally produced by a man getting the coal by means of a pick?—That is so.

19187. Are you disposed to think that the introduction of the coal-cutting machine is a success, and that you will go on with it?—It is more successful in certain parts of the country than it would be with us. In the steam coal in South Wales cutting by machinery is not quite a success. In consequence of the thinness of the seams it makes it very expensive in South Wales to get the thin seams cut at a reasonable price. We have simply tried one of the machines to see what the effect would be.

Digitized by Google

19188-9. You are not sure whether the result is satisfactory or not ?—Not yet.

19190. Can you suggest any precautions which ought to be taken where the coal-cutting machines are used ?—I cannot suggest anything more than is being done at present.

19191. What is being done at present ?—We have watering in some cases, not very far from the faces. We do not water the faces.

19192. You water close by ?—In some cases we do.

19193. So that the very fine dust would not penetrate very far away from the face ?—Yes.

19194. It would be stopped by the water ?—Yes, the fine dust produced now is in the cut underneath the seam of coal, and it is when the coal is brought down and filled into the tram that the dust in the cut is exposed.

19195. And the ventilation carries that about to some extent ?—Yes, to a very slight extent.

19196. You say as to the screens that the quantity of dust that falls down the pits would be reduced by the adoption of a system of watering at the pit top. You do not mean spraying the pits, but watering the coal ?—Watering the coal as it is being tipped.

19197. With regard to partial watering; where it would be either difficult or impossible to water the roof and sides do you think there would be any great advantage in watering the floor only ?—In some seams you can only water the floor, and that very slightly.

19198. That does not do any harm ?—If it is done very slightly.

19199. I suppose only watering the floor has a good effect because with the current of air the ventilation is constantly taking the fine dust off the roof and sides and depositing it on the floor where it gets damped ?—Yes.

19200. So that to a very great extent a very slight watering of the floor hinders the accumulation of dust in the mine ?—Where it is possible to do it I believe it is a good thing to be done.

19201. You say, with regard to watering, that in the steam coal pits of Glamorganshire the system of watering the main roadways by means of pipes is generally adopted; that is to say where you can water you do ?—Yes. I have a statement here if you care to look at it. I have had returns from a good number of companies in South Wales stating the system of watering and the length of pipes that they have, and I should like to put that in if I may.

19202. Certainly; and if you have any observations to make on those systems we should be very glad to hear them. and also which systems you consider best ?—I will hand them in.*

19203. (*Mr. F. L. Davis.*) Will you tell us the system generally adopted ?—The system that was adopted in the first place was pipes with sprays attached to them; but the sprays became very objectionable. The hole was a very fine hole of something like a needle point and the water which was forced out of that was simply deposited in one position, consequently on one side of the spray you might have the roadway not watered at all. The water would be going out in one direction only. Then it also became very objectionable in this respect, that the men passing to and fro in walking the roadways got thoroughly damp, and sometimes they would stop the sprays or damage them.

19204. (*Chairman.*) Surely the sprays only going in one direction and failing to act in every direction, as they ought to have done, was due to some mechanical defect ?—That was not so. I will show you the spray. (*Producing.*)

19205. That is only where you have one hole; but in some mines they have a spray with a lot of holes like the rose of a watering can going in every direction. You cannot use this ?—No, these sprays were very generally adopted in the collieries in Glamorganshire. but it has been found by experience that the better system was to have a hose and get a man specially appointed to go round the roadways to do the watering by means of the hose. I think if you look at the returns you will find that from most of the collieries in Glamorganshire the spray system has been superseded by the man and hose system. It is more expensive but it is found to be far preferable, and the watering is done more thoroughly.

19206. Are there any other types of sprays ?—We have tried one or two others. There was one, a rotary spray, which I think you saw when you were down pit No. 8, but that has not been a success.

19207. Why ?—It got damaged; and the quantity of water even in that case was simply concentrated on one particular point.

19208. It ought not to have been concentrated on any particular point ought it, if the machinery acted properly ?—The air current is all in one direction; and that goes in at considerable force, so that when the water is spread out of the revolving spray it is carried to a certain distance. They are very liable to get out of order.

19209. Although it is a more expensive system, in nearly every case in South Wales you have adopted the man and hose system instead ?—Yes. In that case the roof and sides and floor where it is possible to water them is done more efficiently than in any other way.

19210. You say in addition to pipe watering you have iron tanks and casks drawn by horses used for watering floors in connection with shot-firing. I suppose you find that less expensive than the man and hose system in shot-firing ?—I do not know that it is less expensive.

19211. (*Mr. F. L. Davis.*) That is additional ?—That is additional to the pipes—where the pipes do not reach.

19212. (*Chairman.*) Sometimes a shot has to be fired where you cannot get the pipes in ?—That is so.

19213. With regard to shot-firing, it has been suggested by some of the witnesses that in a very dry and dusty mine it would be desirable to water more than 20 yards round the hole. What do you say to that ?—I think if you water sufficiently 20 yards about the hole that is enough. ✓

19214. If you regularly drench it ?—Not quite drench it, but if you water it as we do our watering now. You do not want to drench it. ✓

19215. As you do your watering now you think it is quite sufficient ?—I do.

19216. Have you had any disasters lately owing to shot firing ?—Not lately; we had one in 1896.

19217. Since 1896 you have not had any disasters due to shot-firing ?—Not due to shot-firing.

19218. In 1896 it was at Tylorstown ?—Yes, Tylorstown.

19219. You say that zone watering might be tried, and that would have the effect of stopping or diminishing the force of an explosion. You say that these zones ought to be arched with bricks or stone, and kept constantly wet by means of sprays. Sprays you would use in that case ?—I think I would, because they would be fixed, and they need not go into the roadway. The sprays would be against the walls on each side. At present the sprays deliver their water into the centre of the roadways.

19220. Can you in the South Wales mines fix up an archway and make a zone always wherever you like ?—Not wherever you like. There might be certain favourable places where you could put an archway.

19221. You would be in favour of trying that system wherever you could reasonably put up an archway that would stand ?—Yes. ✓

19222. If you could water the whole mine completely that would be the safest thing to do ?—Yes. ✓

19223. So that you think wherever you have a mine. where the strata allows of doing so without any great danger from additional falls of roof and so on, then you should water the whole mine ?—Yes, by pipes.

19224. If that cannot be done the next best thing is to have zones as regards watering, at all events ?—Yes.

19225. Then you refer to the removal of the dust by brushing and apparently you are not very much in favour of that plan ?—No.

19226. You think that when the dust is brushed from one spot it would settle on another, and that to remove the dust out of the whole colliery by that means would not be at all practicable ?—That is so.

19227. Have you tried any system of brushing ?—No, I have never tried a system of brushing the sides; the sides of the strata and timber are so rough that there is nothing that presents a smooth surface.

19228. You cannot do it ?—You cannot do it.

19229. You would have to have prepared zones for brushing, the same as you would watered zones ?—The stones are jagged, the timbers are rough, and then there

* See Appendix II.

Digitized by Google

Mr. D. Hannah

2 May, 1907.

are timbers set at every yard or two, so that it would be impossible to brush the dust out of the colliery.

19230. So that whatever might be the case in other collieries, you do not think that in your South Wales collieries the removal of dust by brushing would be of any use ?—No.

19231. Then you add that the floors of the roadways are periodically cleaned, and the dust and the rubbish are either sent to the surface or stowed underground ?—Yes.

19232. How do you deal with this dust that is either sent to the surface or stowed underground ? You damp it, I suppose ?—Yes, it is damped as it is being filled, and then it is sent to the surface in some cases.

19233. Sent dry or damp ?—As it is loaded generally. The roads get filled up with coal, shale, dust, and things like that and most of those roads are watered in the usual way, by a man and hose system ; then that is filled into trams, and it is sent to the surface in some instances ; in other cases it is stowed underground.

19234. When it is stowed underground I suppose it is stowed damp ?—The dampness due to the ordinary watering in the colliery, but it is not specially damped.

19235. But in point of fact it would be generally damp, I suppose ; there would be very little dry dust stowed away in a mine, because it would blow away by ventilation and settle somewhere else, would it not ?—It would not in rubbish stalls, because in rubbish stalls the ventilation is very feeble.

19236. So that it would not kick up the dust that was there which might be almost stowed dry ?—Yes,

19237. And it would not affect the rest of the mine, or would affect it very little ?—No.

19238. When you send it to the surface I suppose you generally damp it : you would not send it dry to the surface ?—Well, in the same way as I have explained : the dust on the roadways is usually damp, and then when it is sent to the surface it is hauled away some two or three hundred yards to a rubbish tip ; it is not tipped in the same way that coal is tipped to the screens.

19239. So that it might or might not be dry—just as it happens ?—Yes, just as it happens.

19240. Then you say as to the cost of watering, that without having regard to the effect on roof, sides and floor —that is to say eliminating it, I suppose—the watering will cost about 1d. per ton on the output. Do you mean that the interest on the plant which you have to set up for watering is included in that 1d. per ton ?—I have not calculated any interest on the outlay in that case. It is not quite 1d. per ton upon the gross output, but we have 26 miles of pipes laid at our collieries, and we find that the cost of watering on the gross output of the coal is about ¾d. or 1d. per ton. We often calculate our cost upon the output of large, and then it is about 1d. per ton.

19241. You have now a sufficient quantity of pipes all through the mines to enable you to water efficiently where it is possible to water ?—We have 26½ miles of pipes out of 76 miles of roadways : we have 76 miles of roadways underground, excluding roturns.

19242. And you have pipes along 26 miles ?—Along 27 miles, I think it is now.

19243. But then supposing you had put zones, they would entail, I suppose, a very large increase in the mileage of pipes ?—If you had zones, and if you took the pipes to the zones, that would increase the mileage, of course.

19244. That would mean a very large increase in the mileage of the pipes ?—Yes.

19245. It would mean a very large increase in the initial expenditure of the watering ?—Yes.

19246. So that you would have to add the increase on that expenditure to the 1d. per ton ?—Yes.

19247. And also if you had a system of zone watering, I suppose there would be a certain amount of expense connected with the upkeep of it ?—Yes.

19248. Which you do not take into calculation now : you simply take into calculation the expense of keeping up the water on the 27 miles that is now covered by pipes ?—We allow depreciation in the 27 miles of pipes : we do not allow any interest on the outlay.

19249. You go on to say that the increased cost of repairs and pit wood as a result of watering is estimated at 5d. per ton. How do you get at that estimate of 5d. per ton ?—It is only an estimate ; of course, I have gone into the matter. We have some cases where we have a place naturally wet, and with a very bad roof, and the cost of maintaining those roads is very expensive indeed.

19250. Then you mean that supposing you were compelled by law to water the whole of your mines and to have a complete watering of the whole of your mines, the effect on the roof and sides would be so disastrous that the repairs would come to about 5d. per ton ?—That is my opinion. It is an estimate.

19251. But it would be possible then to have a complete system of watering in your mines, and the result of that would be that you would have to pay for repairs a sum equivalent to 5d. per ton ?—Yes ; but in addition to that the danger would be very much increased from other sources.

19252. The danger from falls of roofs and sides would be increased ?—Yes.

19253. Would you say that in your opinion the lives which would be sacrificed by the further danger of falls of roof and sides would more than counterbalance the lives that would be saved by the system of complete watering—in the matter of explosions ?—I think so.

19254. Then in paragraph (15) of your statement you say that where the roof and sides permit, general watering is preferable to partial or zone watering ?—Yes.

19255. (*Mr. F. L. Davis*). I think you mean there, as you have already said, general watering where it can be done ?—Yes.

19256. (*Chairman*). Where it can be done : it is prefaced by the words "Where the roof and sides permit." On the other hand, zone watering is preferable to no watering at all, and is also preferable to any system of brushing away the dust—at all events in your mines ?—Yes.

19257. You go on to deal with the dangers which might arise from excessive watering, namely, heaving of the roads, and so on, and you say that you could not pave the floors of your collieries with bricks, as they would be constantly heaved out of position ?—Yes.

19258. I suppose in some places you could do so ?—No, not very well ; the heaving at the bottom would take place.

19259. Almost everywhere ?—Yes, almost everywhere.

19260. You say that on steep roadways where the haulage is done by horses, watering the roadways makes the roads greasy, and the heavy trams, even when fully spraggod, often overpower the horse, causing danger to both man and horses ?—Yes.

19261. The spragging is a system of brakes, is it not ?—Yes—blocking the wheels.

19262. So that there there would be another danger ?—Yes : there is a very large number of accidents due to haulage accidents, I think rather greater than falls of roof and sides, in South Wales.

19263. Then do you mean to say that the horses absolutely run backwards ?—If the gradient is steep and the roads are greasy, then the heavy load of the trams very often overpowers the horses going down hill.

19264. I thought you meant when pulling it up-hill ?—No.

19265. When a horse goes down the hill he is overpowered and the tram runs over him ?—Yes.

19266. Then you add, in your last parag aph, that you think watering is the most effective method of dealing with the dust in collieries ?—Yes.

19267. Then you give certain tables. Is there anything in the tables which you would like to draw attention to ? Mr. Cunynghame will probably cross-examine you upon the question of the cost of watering, which seems to be the principal matter here ?—The first table shows the number of yards of roadways that we have, and the last column of that table shows the number of yards of pipes, so that the total length of roadways is about 76 miles, and the length of pipes 27 miles ; so that rather more than a third of our roadways is laid with pipes.

19268. You deal in one of your tables with analyses of coal dust. Is there anything you would like to add with regard to your analyses ?—I have the samples here ; the analyses have been made by a chemist at Cardiff, but I cannot speak as to the chemical properties of that myself.

19269. We will put these tables in ?—Yes.

19270. (*Mr. Cunynghame.*) You have put in a table showing an estimate of the annual cost ?—Yes.

19271. That is based, apparently, upon the total output of 1,250,000 tons ?—Yes, of large coal.

19272. I gather so. Does the total annual cost include interest ?—No, not including interest.

Digitized by Google

19273. It is not counting interest, but counting repairs and depreciation?—Counting repairs and depreciation.

19274. That is to say, repairs and replacement of damaged and worn-out parts?—Yes, and extensions for that year.

19275. It would come to about £5,000 a year, roughly speaking, on the eight pits, which, at 1,250,000 tons of output, would come to about 1d. per ton. That is what you work it out at?—Yes.

19276. Now we must allow also, I suppose, interest on the cost of the installation?—Yes.

19277. That would not be a large figure: the cost of installation is about £3,500, apparently?—Yes.

19278. So that we have interest at 5 per cent., or something like that?—Yes—£175.

19279. It would come to not more than £200 a year as the amount to be added to it?—About that; not more than that.

19280. Then your depreciation figure of pipes and fittings seems rather high; you have put 50 per cent. upon fittings?—Yes.

19281. I should think that is rather high, is it not?—No, it is not high at all; it is a very careful estimate.

19282. I suppose your depreciation means really a repair account as well—repairs and depreciation?—No. We consider the pipes: for instance, we depreciate the pipes at 20 per cent.

19283. But does not that bill include any necessary repairs that have to be done to the pipes in the year? I mean depreciation of capital is one thing, and repairs is another.—Yes.

19284. Of course you may lump them if you like. I am merely asking you what you have done here.—We employ 37 men to look after these 27 miles of pipes, and their wages are included in this statement, so that they of course attend to the repairs, but the depreciation of the pipes I estimate at 20 per cent.

19285. Then, at all events, you would put 1¼d., including interest and everything else, as a good liberal allowance. Your figures work out to 1d., and I have given you ¼d. more for interest and unforeseen expenditure?—Yes.

19286. 1¼d. would cover it well, I suppose?—Yes.

19287. What sort of watering does that contemplate; is that general watering, or complete watering?—Man and hose watering.

19288. Complete?—No, not complete; it does not water the whole mine. In this particular case, our own case, we water about one-third of the roadways, that is to say 26 miles. We have 76 miles of roadways.

19289. Why do you leave two-thirds of the road unwatered?—We do not think it necessary to water them.

19290. What is the reason why it is not necessary to water the remaining two-thirds?—The most dangerous roads, in my opinion, are the engine planes, over which the coal is drawn by mechanical haulage, and in nearly every instance we have pipes along those roadways. Then in many other cases we have pipes on our main headings—horse haulage roadways. Then, when you come to the smaller headings and stall roadways, the current of air is very feeble, and it is not necessary to water there.

19291. Among the two-thirds that are not watered, are there left any long pieces of road along which an explosion could get up force, or does the watering that you do pretty well break the remainder up into zones? Please quite understand the question: you see the drift of it?—Yes. I take it that your meaning is that in the headings and stalls, where the currents of air are not so strong, the explosion would not be so fierce.

19292. I mean that it would not get great lengths to go would it arrive at some watered place which might intercept the explosion and cut it off, as it were?—Yes, that would be so to a certain extent. Of course it would come back to the main haulage roads.

19293. Can you say what is the longest stretch of unwatered road in your mine that you can remember: that is to say, of unwatered roadway of any sort—stall road or anything else?—Some hundreds of yards.

19294. How many, because that is not very great—it may be 100 yards, perhaps?—I could not say exactly, but I daresay there are cases where there might be 500 yards of unwatered roadway.

19295-6. It might be wise, might it not, if we were adopting a zone system, to cut that in two by a watered space in between, so as to provide that there should never be more than a certain number of yards unwatered?—You see the object of it, do you not?—I do. That would depend upon the nature of the seam which you worked. In certain seams that might be desirable; in other seams of coal it would not be at all necessary.

19297. I suppose the reason you say it is not necessary to water them is that they are not dusty?—They are not dusty to the same extent as the other seams: there are some seams which would be very dusty—naturally dusty.

19298. Still it would be a very good rule, would it not, that in dry mines there should not be a greater extent of roadway anywhere than a certain number of yards without meeting an intercepting point so as to stop an explosion if it ever began there?—I should not like to say that. I do not think it would be necessary in some seams to do even that.

19299. (*Mr. F. L. Davis.*) I think one reason why there may be long distances is that in certain mines they cannot water because of bringing down the whole place?—Yes.

19300. (*Mr. Cunynghame.*) I should like to ask you this question: take the case of a road where you say it would be very undesirable indeed to water for fear of bringing down roof and sides, and take in your mind a rather extreme case; would it be true that if you watered a little might come off the face, but that after that the evil would be at an end and you would not have any more harm by further and subsequent watering?—No, that would not be so.

19301. Do you mean that if you watered on one day a portion would come down, and if you watered the next day a portion would continue coming down until you brought everything into confusion: is that what you wish to put before us?—What I wish to say is this: if you can imagine water being thrown on lime, that is the effect it has; it is not simply covering it with water and a little coming down in consequence, but it is like yeast—the moisture works through the whole ground and pulverises the whole ground if watering is done to anything like the extent that you wish to have it done.

19302. But supposing that you did a minimum amount of watering—the least amount possible that was necessary for reasonable safety—and did that daily, we will say or from time to time, would the roads in parts of the mine which you have spoken of still be really ruined?—It depends entirely upon the extent of the watering. If you watered very little it might not be efficient.

19303. But I am putting it that you must water efficiently or else it is no use watering at all.—If you watered efficiently, then the danger would be very great. ✓

19304. Then it is not right to say that a daily watering would do some harm to start with, but that it would not go on doing harm, and that it would stop. I should like you to be quite clear and precise upon that point.—Yes, I am quite clear: my opinion is that where you do daily watering. the danger is very great, because the effect of watering upon the shale is very much the same as putting water upon lime; it would tend to swell the ground and pulverise the ground, whereas if you kept it entirely dry that shale would remain in its original condition without breaking. Once you put water upon it, it pulverises it, which necessitates the timbers being set closer together, and when the falls do take place they run up very much higher, causing great cavities in the roof and places where gas would be likely to accumulate and does accumulate. ✓

19305. I see that in your statement you give an analysis of coal dust, of which the first column, giving the percentages of ash, appears to be very interesting. I notice that sample No. 3 contains only 3·74 per cent. of ash?—Yes.

19306. Whereas another sample from the same seam contains as much as 20·72 per cent. apparently, and another as much as 14 per cent.?—Yes.

19307. (*Mr. Ratcliffe Ellis.*) One is face dust and the other is horse haulage dust. The face dust would be pure coal dust, and the other is coal dust mixed with something else?—Yes.

19308. (*Mr. Cunynghame.*) That is what I was going to ask you to explain. Are we to take it that sample No. 3, which contained 3·74 per cent. of ash and 81·76 per cent. of carbon, is the normal figure for that particular coal—I do not mean that it is the invariable figure, but the general figure for the coal itself?—That I cannot say. I am not a chemist and I do not pretend to speak upon these matters. I have taken samples of dust from these particular parts of the mine, and I have sent them down to an analyst at Cardiff, who has analysed them, and the results are

Digitized by Google

Mr. D. Hannah.

2 May, 1907.

given here; but beyond that I am not in a position to speak.

19309. You are not able to say whether the large percentage of ash in other cases is really due to some powdered stone that had got in?—I should think the stone on the roadways, and the shale which is trodden down by horses and men in walking along roadways.

19310. You mean that is what has produced that effect?—Yes.

19311. So that in this mine we might expect to find dust on the roads of very different composition?—Certainly.

19312. And of different degrees of inflammability, probably?—Yes, I should say so. I have here some plans, if you would like to see them, showing all the water-pipes on the main haulage road. (*The Witness produced plans.*)

19313. I was prepared to take it from you that, from your experience with regard to certain places, you could not go on with the watering?—These are plans of the whole of our roadways and of the whole of our workings at our collieries; there is nothing selected at all.

19314. (*Chairman.*) They show where the pipes go?—Yes. (*The Witness explained the plans to the Commissioners.*)

19315. (*Mr. Cunynghame.*) Will you show me the longest piece unwatered?—The biggest piece unwatered would be in No. 1 pit in the 2 ft. 9 in. seam. (*Indicating.*)

19316. (*Sir Lindsay Wood.*) I notice that you have 1½ in. pipes or 2 in. pipes?—Our largest pipes at present are 2 in.

19317. Are the 2 in. pipes next the out-bye end?—Yes, next to the pit shaft.

19318. What pressure have you there? You must have a large pressure?—We have about 600 lbs. pressure.

19319. Do you get any damage to those pipes from falls of stone or anything of that sort?—They are occasionally damaged in the course of repair. I have included that in the depreciation.

19320. That is in the cost?—Yes, in the cost.

19321. But supposing a fall came and broke these pipes at 600 lbs. pressure during the night when no one was in the pit, what would be the effect?—Of course, it would cause a lot of water to be spread about the place, but it would soon be discovered and be shut off by the main cocks near the pit bottom.

19322. Have you any means of stopping the water?—Yes, we have main cocks at different parts of the pit.

19323. So that you could stop it as soon as it is found out?—Yes.

19324. But still a large amount of water might get into the mine before it was discovered?—It would not be sufficient to make it dangerous before it was discovered; it might cause a lot of damage to the sides and roof, of course.

19325. I mean it would damage the mine?—It would damage the roof and floor.

19326. Of course it depends very much upon how often the pipes are inspected during the 24 hours. On a Sunday, perhaps, they are not seen for many hours?—The firemen go down on Sunday morning and make an inspection, and the ostlers go down twice a day to feed the horses.

19327. Are these stables a long way in-bye?—In some cases they are.

19328. I take it the pipes would be inspected then every day?—Yes, they would be inspected every day.

19329. (*Mr. Ratcliffe Ellis.*) You have not said anything about shot-firing in your evidence?—No.

19330. What is the method that you adopt at your colliery, first of all at the face and next on the haulage roads?—At the face we only use explosives in strong stone roof.

19331. Not in the coal?—Not in the coal.

19332. Then when are those shots fired?—The colliers drill the holes in the roof when it is necessary to blast the roof, but they are not allowed to charge them; there is a special man appointed for doing the charging and for putting in the detonator, and then they are fired between the shifts by the fireman.

19333. Then what the collier does is to drill the hole?—Yes, only to do that.

19334. It is charged then by specially appointed men?—Yes.

19335. And it is fired between the shifts?—That is so.

19336. Is that the same principle as you adopt on the roads in shot-firing?—On main haulage roads and engine planes of course that is very rarely done. The Manager has to give permission for any shots that are fired there, and in some cases it is left until Saturday, at the end of the week, when there is no one in the pit except those engaged in preparing and firing the shots.

19337. Then there is no shot-firing on the main haulage roads except with the express permission of the Manager?—That is so.

19338. He has to authorise it?—Yes.

19339. That is not the case with reference to ripping shots at the face?—No.

19340. Who decides whether they shall be fired or not?—The Overman and the fireman at the colliery.

19341. The hewer has nothing to do with it?—No: the hewer generally tells the fireman that he wants a shot put in at such a place, and then the fireman examines and sees that it is all right, and then he authorises him to put a shot there. That is the usual practice.

19342. What do you fire with—electricity?—Yes.

19343. Have you any prescribed interval, if a shot miss-fires, before which the man should not go to the shot?—There is the rule that the place is to be fenced off if a shot miss-fires; but that very rarely happens to us, because we test the detonators before they go down, and we had only two miss-fires last year out of 15,000 shots fired.

19344. How do you test the detonators?—By a galvanometer: it is done by our electrician.

19345. Do you take one out of a number?—No, they are all tested.

19346. Then the rule is that before another shot is fired the place must be examined?—We never fire two shots in the same place at the same time except in the case of hard headings—stone headings. But in the ordinary roof we fire one shot in the roof, and they are fired separately.

19347. Is there any rule which you are aware of now prohibiting more than one shot being fired at a time?—No, but there are certain provisions in the new Explosives Order that after one shot is fired you have to inspect before the second shot is fired.

19348. There is no provision that you must not go there within a certain time?—No.

19349. Do you think that it would be useful that there should be a rule that only one shot should be fired at a time?—I think so: that is to say in the roof.

19350. I am speaking now of shots in the roof. Do you suggest that in the main road not more than one shot at a time should be fired, or would you make them general with certain exceptions?—Do you mean the firing of one shot at a time?

19351. Yes.—I think I would make that a rule in main haulage cases.

19352. With power to give exemptions in special cases?—Yes.

19353. Then would you think it desirable to make a rule that there must be an examination for dust as well as for gas before a shot is fired?—If the rule is carried out, and the watering done within 20 yards, the presumption is that there would not be any dust there.

19354. You think that is sufficient?—Yes.

19355. Then do you not think that the distance of 20 yards requires extending?—I do not think so.

19356. The drilling of the hole is a very important part of shot-firing is it not? Yes.

19357. That is done by the collier?—Yes.

19358. Have you any Special Rules detailing what the collier has to guard against, or what he has to do in drilling a hole?—No: no special instructions are given.

19359. Supposing you are drilling a hole, what would you consider it necessary to be careful about?—To get the hole drilled true, of course, is very important.

19360. And when the hole is drilled, can the man who charges it see whether it is drilled sufficiently true to be safe to prevent a blown-out shot?—He would probably try the hole before he would insert the explosive, to see whether it was in order.

19361. Is there any rule requiring that?—There is no rule requiring that.

19362. Do you think it desirable that there should be a rule prescribing either for the collier how the hole should

Digitized by Google

be drilled, or prescribing that the person who charges the shot should see that the hole is properly drilled ?—I do not see the necessity for such a rule.

19363. They would do that, of course, but if there is no rule do you think it is desirable that it should be called to their attention by having a rule ?—Judging from the number of shots we have fired without any difficulty of that sort, I do not think there is any necessity for that.

19364. Not at your colliery ?—Not at our colliery.

19365. But do you think that generally, for the benefit of other people, it would be desirable to embody it in some rule ?—I should like to know what is the point in your mind which you fear in that case.

19366. I am afraid of a blown-out shot, because that is a very dangerous thing ?—Yes.

19367. In order to guard against a blown-out shot, you say it is very important that the hole should be carefully and properly drilled ?—Yes.

19368. You have no rule requiring that to be done ?—No.

19369. I am asking you whether it is desirable that there should be some rule made securing that ?—If it is possible to frame a rule to prevent blown-out shots, it would be very desirable ; but during the whole of last year we fired 15,000 shots, and we had not a single blown-out shot.

19370. You had a rule about stemming—as to how it should be stemmed, and what it should be stemmed with ?—Yes.

19371. You have no rule as to the drilling of the hole that I am aware of. Do you think it is desirable that there should be such a rule ? Of course, you think it is desirable that the hole should be drilled very carefully, and in the way that you have suggested, but there is no rule prescribing that ; do you think there should be such a rule ?—We have never had any difficulty, and we do not quite see where the necessity for such a rule comes in.

19372. How does a collier learn to know how to drill a hole ? Somebody teaches him, I suppose ?—He learns by experience. There are generally two men drilling a hole, one of whom has had experience before ; and then one man "sledges," and the other man turns.

19373. The principal cause of blown-out shots is that the hole is improperly drilled or improperly charged ?—Improperly charged, I should say—overcharged.

19374. Then you think they know sufficient about it, and that it is not necessary to have a rule ?—I do not think a blown-out shot would be due to a hole being improperly drilled ; I think its being overcharged would be the cause of a blown-out shot, probably.

19375. (*Mr. Smillie.*) Or bored into the solid ?—Or bored into the solid probably.

19376. (*Mr. Ratcliffe Ellis.*) What method have you adopted to instruct your shot-lighters as to their duties ?—We have carried out the Rules laid down by the Explosives Order. First of all, they have to have the explosives and detonators carried in a box which is securely locked.

19377. What means do you take to instruct them as to this ?—First of all they have to be appointed in writing, and when their appointment is made they are given general instructions, and told what the Rules are.

19378. Who gives them the instructions ?—The Manager of the colliery.

19379. Does he give them instructions by word of mouth, or does he hand to them a copy of the Rules ?—He gives them instructions by word of mouth, but all our men have the Rules. Every workman is supposed to have a copy of the Rules.

19380. Do you think it desirable that the men who have to deal with shots should have not merely a copy of the whole of the Rules but that they should have a copy of those Rules relating to their particular duties ?—Yes ; we try to instruct them in that so far as we possibly can. Of course, with regard to our shot-firers, when we appoint them we are careful in the appointment of the men to do that work, and we are very particular about the instructions that they receive.

19381. You give them instructions by word of mouth, you say ?—The manager does ; and then they are supposed to know the Rules.

19382. Exactly—they are supposed to know the Rules, but do you think it would be an improvement if, instead of giving them the whole of the Rules they had the Rules relating to their particular duties as to shot-firing ?—Yes, I think so.

19383. How do you deal with the explosives ? Do you supply the explosives to the men ?—Yes.

19384. And to contractors and everybody. Do the contractors buy their explosives from you ?—We have no contractors.

19385. But at any rate you supply all the explosives ?—Yes.

19386. Do you fire them electrically ?—Yes.

19387. In the Electricity Rules is there anything which occurs to you that requires amendment as to the use of electricity in the mines ?—Apart from shot-firing ?

19388. Either in connection with shot-firing or apart from shot-firing ?—No, I cannot suggest anything at present. The Electricity Rules appear to me to be rather rigid in some cases.

19389. Do you use lamps throughout the pit ?—All locked lamps.

19390. With reference to the coal-cutter, you were experimenting with that, you say ?—Yes.

19391. But is the difficulty that you have in establishing this a commercial difficulty, or is it that it is dangerous in some way, and that you wish to avoid some danger ?—Do you mean in using the coal-cutter at all ?

19392. Yes.—We are hoping to work the coal cheaper by using coal-cutters and having it cut. The difficulty in our thin seams is to get the coal cut.

19393. Yes, but where you could physically get it you said you were trying it. Is your difficulty a difficulty in settling the rate of wages which have to be paid for the coal cut with the coal-cutter, or is it because you think there is a danger in using the coal-cutter ?—I do not think there is any danger in using the coal-cutter.

19394. Then you would not hesitate, from the point of view of danger, to use the coal-cutter ?—No.

19395. How is the coal-cutter driven ?—By compressed air.

19396. The dust from the coal-cutter is very fine, you say. Have you been holing in the coal or in the dirt underneath the coal ?—In the coal.

19397. And it makes a finer dust, you say ?—Yes.

19398. It leaves that in the hole ?—Yes.

19399. But then when the coal comes down it brings it into suspension ?—The coal simply drops on it. As a matter of fact, the small coal that is left in the cut is sufficient to keep the coal up until it is brought down by the collier. We tried to hole in the stone underneath, but it is too hard for the purpose.

19400. The better the ventilation and the more air there is the more you are likely to have the dust blown about ?—Yes.

19401. With reference to moving the dust and clearing it away, do you do any systematic removing, or do you simply remove it for the purpose of getting it out of the way of work ?—There is no systematic moving of the dust itself, but the roadways in course of time become filled up and then the roadways are cleaned.

19402. Then you remove the dust because you cannot get along the roadways ; you do not remove it for fear of an explosion ?—No.

19403. If you water to the extent that in your view is necessary to render the dust harmless, you would do very considerable mischief to your roadways ?—Yes.

19404. You say that you would have openings in the roof ?—Yes.

19405. Is it prejudicial to ventilation to have the roadways in that condition ?—Yes, I should say it would be to a certain extent, because where you draw large falls of roof the falls extend sometimes up to 30 ft. above the top of the roadway, and there is very great danger in those cases of getting these cavities filled up with gas.

19406. Then that would be another danger which might arise ?—That is a very serious danger.

19407. Because you might have another danger brought on, not merely of injuring people from falls of roof, but you might have accumulations of gas about, which your air did not reach ?—That is so.

19408. In dealing with the estimate of this cost you have estimated the cost of putting down the plant ?—Yes.

19409. When do you do these repairs which would result from the watering—between the shifts ?—No, during the shift.

Digitized by Google

Mr. D. Hannah.

2 May, 1907.

19410. Does that not to some extent obstruct the working of the mine ?—No.

19411. Then you can do that whether you have to do repairs or not ?—Yes.

19412. Have you any experience of rescue apparatus ?—Do you mean of special breathing apparatus ?

19413. Yes.—No.

19414 (*Chairman.*) You said that there were two miss-fires out of 15,000 shots. Did you investigate the cause of those miss-fires ?—I think they were generally found to be in the detonators—that the detonators did not go off.

19415. I understand you to say you tested the detonators ?—We test all the detonators, but even if they are tested there is just a possibility of miss-fire when they are sent down the pit.

19416. Then the testing is not absolutely conclusive ?—Of course it reduces it down to a minimum. If a detonator is at fault then it is not sent down the pit.

19417. Then you sometimes find they are at fault ?—Yes; we find about 1½ to 2 per cent. of failures in the detonators.

19418. So that if you had not had that system of testing the detonators before they are sent down there would have been probably 1½ or 2 per cent. more of miss-fires ?—That is so.

19419. Did you find out what was wrong with those detonators ?—No, I cannot say exactly. They were submitted to our electrician, and I suppose the contact, or bridge forming the contact, got broken.

19420. (*Mr. Ratcliffe Ellis.*) When you have a miss-fire occur is it recorded anywhere ?—Yes.

19421. Who records it ?—The fireman.

19422. In his book ?—Yes. It is from there that we have obtained our record of the shots which have been fired and the number of miss-fires.

19423. Have you a statement of the number with you ?—I have not.

19424. But it is contained in an ordinary report book ?—Yes.

19425. The fireman reports the number of detonators that he took down, I suppose ?—He reports the number of shots that have been fired and the effect of them.

19426. And whether there was a miss-fire ?—Yes.

19427. He gives you a record of what he has done ?—Yes.

19428. Now, with regard to the cost, the cost of watering you gave at 1¼d. per ton, but that only extended to two-thirds of the roads ?—To one-third of the roads.

19429 Then that would mean that if you watered throughout, the cost would be a great deal more ?—Yes.

19430. As one-third is to three; that is three times 1¼d. ?—Yes; roughly that; it might not be quite as much.

19431. (*Mr. Wm. Abraham.*) What do you say the cost of the watering is as you do it now ?—The cost of watering would be pretty nearly 1d. per ton.

19432. And that would be, as I think you stated very plainly, on the price of large coal ?—Yes, on the large coal cost. If you take it on the gross output it would be less per ton, of course.

19433. How much less ?—Then it is about ¾d.

19434. In regard to shot-firing, are we to understand that you are speaking for all the steam coal collieries of Glamorganshire or of the collieries under your own management ?—Of the collieries under my own management at present. The information that I have obtained from the collieries in Glamorganshire is with respect to watering.

19435. But you know a good deal of other collieries, I take it. Do you think that the regulations with regard to shot-firing—the collier, as has been stated, simply drilling the hole and having nothing to do with charging it—are carried out generally ?—No, I do not say that. It is not an obligation to do so.

19436. Quite so. You would agree, from your own practical experience, that it would be well if we had a rule making that a condition ?—Do you mean that the collier should not charge his hole ?

19437. Yes, that another man entirely should do it ?—Yes, that is my opinion.

19438. And you agree with Mr. Ellis, I think, that it would be well if we had a rule to that effect ?—Yes, that the collier should not charge his hole, but that he should simply drill the hole, and that a specially appointed person should charge it and fix the detonator and then that the fireman should fire it between shifts.

19439. You find, in your own experience, that the spraying you do is very effective in allaying the coal dust which would otherwise arise from the dust falling off the top of the tram in the transit ?—Yes.

19440. So far as regards the dust arising from the tram in transit, you are satisfied that what is necessary to be done is being done ?—Yes.

19441. Do you speak now of all the collieries, or again only of your own ?—I think I can speak of all the collieries with regard to that. I put that as a question in the questions that were sent out, and you will find that is generally complied with—that there is a spray over the journey before it starts from the double parting, and that the journeys are damped before they start out. That is being generally adopted.

19442. Have you at any time experienced any difficulty with screening in consequence of the damping of the coal that you do in that way ?—We have not done so. We only suggest it as a possibility of improvement. We have not damped the coal in the tipping of it to prevent the dust going down the pit. I have suggested that it is possible that might be done.

19443. Quite so, but that is not my point. The spraying which you do now underground is effective ?—Yes.

19444. Its being effective when done to that extent does not create any difficulty with screening that coal ?—No.

19445. (*Mr. F. L. Davis.*) It was sprayed on the top of the tram, and it was not sufficient to penetrate ?—No, it was not sufficient to penetrate down into the bottom of the tram.

19446. (*Mr. Wm. Abraham.*) I know what you mean when you make the statement—that what is done under your management and generally in South Wales is effective ?—Yes.

19447. There is no part of the country anywhere in which screening is more necessary than in South Wales, is there ?—In what way do you mean "more necessary" ? I do not quite understand.

19448. In order to have the coal perfectly screened, because you are selling it as "colliery screened coal"—that is to say, having any amount of small coal mixed with the large in Glamorganshire would affect the sale of the coal ?—Yes.

19449. That is the point. Has the amount of spraying that you have done in any way affected the value of the coal which you sell ?—No, I do not think it has. Of course, I may point out that the coal is not thoroughly saturated: we simply spray the top of the coal to prevent the dust blowing off the top of the tram.

19450. That is exactly what I mean, because all my questions are based on the first one. Further than that, occasionally we now spray the bars of the screen in order to assist ?—Yes: by means of a rag tied at the end of a stick, but that is simply to make the screen bars smooth, and it is not to prevent dust.

19451. Quite so. If that watering would in any way injure the price of coal you would not do it ?—I do not know: it depends. Of course, if the danger is greater, we would.

19452. According to your suggestion it is still possible, in order to allay the volume of dust arising from the screen, to adopt a kind of spray there ?—Yes.

19453. That would prevent the cloud of dust being drawn towards the pit ?—It is possible to do that, I think, but the pressure would be very small on the pit top.

19454. But that could be done if you thought it necessary ?—It could be tried.

19455. And it would not injure the coal ?—I do not think it would very seriously.

19456. You say in your statement that the dust from coal-cutting machines is finer than that made by hand-cutting ?—Yes.

19457. Hence it is to that degree more dangerous ?—A very small degree, but to that extent it might be so.

19458. But I do not know that anyone has disputed the fact that the finer the dust is the more dangerous it is ?—That is so.

19459. Then you do not think it is practicable to deal with that small coal immediately by a clearing out such as is suggested ?—No; not differently to what we do at present, I think.

Digitized by Google

19460. That is left on the ground under the coal?—For the time being.

19461. What is the means of bringing down that coal after it is cut?—The usual pick and bar. Of course, the bottom is cut. The difficulty in a thin seam is to get the cut in the first instance, but once you have cut 5 ft. underneath, then it is a comparatively easy matter to bring the coal down.

19462. But is it not the practice in the thin seams to blast it?—No, not with us.

19463. Are you speaking now for yourselves, or for the Glamorganshire coalfield?—I speak generally so far as blasting is concerned with regard to coal cutters in South Wales. In South Wales if you undercut 5 ft., there is no occasion to blast afterwards, it comes down easily enough.

19464. Not in the thin seams?—Yes, in the thin seams.

19465. Of course it would be easier to work with that cut than without, I agree?—Even if we had no cut at all we should not blast in that seam.

19466. Then if blasting was used to bring that coal down, the fineness of the dust of the small that has been made would increase the danger?—You would not blast and under-cut: you would do one or the other.

19467. I do not know: that is how they get that large output in America, is it not?—I do not know what they do in America, but we do not do it in South Wales.

19468. We are all glad to find that it is not so, so far as your information goes, at any rate. But if it was so it would naturally increase the danger?—Well, the things do not go together at all: the undercutting and the blasting in the coal do not go together in South Wales.

19469. They do not go together in practice?—There is no necessity for it.

19470. I do not know about that. Take the case of the introduction of the coal-cutter to No. 2 Abergorky, would not the men be able to produce much more coal if they blasted it out after holing it with the machine than they would bring down by mandril?—I do not think they would be allowed to do so.

19471. That is the point. You do not think it ought to be allowed?—No. There is no necessity to do so. Of course you cut the coal, and the coal comes in slips; the only necessity is to put a mandril or a bar into it, and the coal comes away.

19472. It would not be desirable for us to have a discussion upon the No. 3 Abergorky Seam, which we know very well. Speaking about steam coal is one thing, but speaking about these thin seams is quite another thing?—The thin steam coal seams, as you know, generally occur in slips, which are about 18 ins. or 2 ft. apart.

19473. And there you cannot use a coal-cutter?—We do use a coal-cutter.

19474. Where?—In No. 2 Pit, Ferndale.

19475. The point is this: to hole the coal with a coal-cutter and to use explosives to bring it down would be a dangerous process?—I say there is no necessity to do that.

19476. That is not an answer to my question?—Well, it is absurd to suggest it.

19477. Not at all, because I have seen it done, but not in South Wales. Is the new tram generally adopted in South Wales now?—Yes, I think they are pretty generally adopted.

19478. To what extent?—They are generally closed in. Of course there are different patterns, but they are generally adopted.

19479. Have we not got the old "screener" at several collieries still?—To a certain extent, of course, but they are being worked out and superseded by the close-sheeted trams.

19480. How many of those old "screeners" have you now?—Very few. They are practically worked out.

19481. How many have you?—I do not suppose we have 10 per cent. of them; and that is only in some pits. In some pits there is not a single "screener."

19482. I am asking now as to our experience and what we know of other places: is it not almost every-day knowledge that very few of these close-sheeted trams are now adopted in collieries?—No, they are generally adopted.

19483. That is to say they have been brought in lately?—They are superseding the old trams.

19484. You have introduced them for 10 years?—Yes, rather more.

19485. And you have still 10 per cent. of the old type left?—No, except in some pits—and that percentage is taking it at the outside. I say that at Tylorstown we have not got that number: I do not suppose there are 5 per cent., and that only at certain pits.

19486. Do I understand you to say that there is no system of removing dust from the roadways in the South Wales mines?—Do you mean the floors, or the sides?

19487. Floor and side.—I do not know of any.

19488. How is it done?—The rubbish is filled into trams and sent out—the roads are made clean. Apart from that there is no other system.

19489. That is to say, speaking of all collieries, there is no system of collecting the coal dust from the roads?—Not as separate from the other rubbish.

(*Mr. F. L. Davis.*) Do you mean dry cleaning—without water?

(*Mr. Wm. Abraham.*) Yes, or even if it was necessary to water it in order to collect it together. We have heard about systems being adopted—that is to say, not an inch of dust being allowed, and so forth. We have not arrived at that yet, have we?

(*Witness.*) With respect to cleaning the roads, our roads are cleaned in the usual way. Of course any rubbish or dust that there may be there, or anything of that kind, is filled into a tram; that is the only system we have adopted of cleaning the roads.

19490. Quite so. That has been done where a lot of it has come together?—When the roads get dirty.

19491. So that they are allowed to get dirty before the necessity of cleaning them is apparent?—Well, you do not want to clean if they are not dirty.

19492. They are allowed to get into such a state oftentimes, for the want of cleaning, that men and horses can kick up the dust and raise it in a cloud?—Yes.

19493. With regard to Paragraph (15) of your statement, as to the effect of watering, you speak of what would be the effect of efficient watering, which you say would cost about three times what it does now—or is it the practical effect of what is now being done?—If you thoroughly water the whole colliery, it would probably cost three times what is being done at present.

19494. That is not my point. You are doing a certain amount of watering now?—Yes.

19495. Does that amount of watering bring about the effect that you say there would be, namely, "The effect of watering the shale, roof and sides in most of the seams in Glamorganshire is to pulverize the ground?"—Yes.

19496. Is the present system of watering bringing that about; does it pulverize the ground?—Where the watering is used; but there are certain places where we do not permit this watering. But, of course, where the watering is used even in the best seams it causes the bottom to heave and to puck, and makes the cost of repairing that very much more expensive.

19497. But is that being done in practice?—Yes.

19498. You have known it?—We have known it.

19499. You have known watering to be done that brings about that result?—Yes.

19500. You have known in practice that watering to such an extent has caused re-opening of the roads to be required?—Yes.

19501. And the watering that you do is often the cause of great falls?—Yes.

19502. You say that the watering of the floors, which are generally fire-clay, causes heaving, which sometimes continues until the roadways have been raised considerably above their original level?—Yes.

19503. Is that the fact?—Yes.

19504. Is it a fact that generally speaking the bottom is fireclay?—Yes, as a rule.

19505. Then you are speaking of the same collieries as you speak of in Paragraph 14 of your statement, where you say, "In the steam coal pits of Glamorganshire the system of watering the main roadways (mostly engine planes) by means of pipes is generally adopted?"—Yes.

19506. And it generally brings about the effect you speak of?—It does.

19507. Are you speaking now of collieries in Glamorganshire generally?—Yes.

19508. It brings that about there?—Yes. I may refer you to the returns I have handed in.

Digitized by Google

Mr. D. Hannah.

2 May, 1907.

19509. (*Mr. F. L. Davis.*) Of course it does so to a greater or less extent in different seams in different places?—Yes.

19510. (*Mr. Wm. Abraham.*) Then all this is being done as it is done now, with all these falls, at about the cost of ¾d. per ton?—Yes.

19511. (*Mr. F. L. Davis.*) No, that is in your own case; you are not speaking of other people's cost?—No, I am speaking of our own. If you will allow me, what I said was that ¾d. is the cost of pipes and labour in watering, but with respect to the effect on roof, floor and sides, it amounts to 5d.: so that with the watering and the effect it means about 6d. per ton.

19512. (*Chairman.*) That is to say, it would amount to 5d. if you had watering done all over the mine, but it does not amount to 5d. now?—No, simply the labour cost in putting down the pipes and fittings, and putting on men to water the roads, without any regard to the effect on the roof, floor or sides; the cost of attending to the watering is about ¾d. per ton; but if you take into account the cost of repairs and consequential damage it would amount to 5d.

19513. That is to say, it would amount to 5d, if you had universal watering all over the mine?—No, I think they are two different points altogether. Universal watering all over the mine would cost three times 1¼d.

19514. But would it cost three times 5d. per ton as well in respect to the repairs and consequential damage?—No. I take it that if you had to do thorough watering the consequential damage due to watering would amount to about 5d.

19515. But supposing you did not carry out the water at all but left the mine to be as dry and dusty as possible and did not attempt to water, do you think you would save in that way 5d. per ton?—Yes; that is as comparing one system with another. If you had not been doing any watering at all, and then you had to do thorough watering, your thorough watering would cost you 5d. to 6d. per ton.

19516. Your present watering, as I understand, is the watering which you consider to be necessary in order to avoid danger; but supposing you put the question of danger out of your mind altogether and take it that you got your coal without any artificial watering at all—supposing it was possible to do that—do you think you would save 5d. per ton on your output then?—No. What I mean is this: I have suggested that if we had to do thorough watering——

19517. That is my point, that if you had to do thorough watering it would be 5d. per ton?—Yes.

19518. Then as I understand it, what Mr. Abraham wishes to get from you is this: whether you consider that the watering which you do at present, which is not thorough watering but only watering where you can reasonably do it, affects to any considerable extent the amount that you have to spend in getting a ton of coal?—Yes, I should say that would perhaps be—it is simply an estimate—2d. per ton.

19519. About a third?—Yes, about a third in addition to the labour.

19520. But the 1¼d. is quite independent of any damage done by falls of roof and sides; that is another matter. As I understand, Mr. Abraham's point is with regard to the consequential damage: he puts it that you only water now where you consider you can reasonably do so, and even that amount of watering, according to your opinion, does cause a loss in working the colliery?—Yes. If I may put it in this way, our present watering costs us ¾d. to 1d. per ton, and the consequential loss is 2d. in addition to that as the watering is at present done.

19521. (*Mr. F. L. Davis.*) And that only applies to a third of the mine; that is the position?—Yes.

(*Mr. Wm. Abraham.*) So that the logic of the argument is this: that the cost of efficient watering would now be raised from what we thought was 4d. to 9d.

19522. (*Mr. F. L. Davis.*) No, I think what you mean is this: that if you were to have universal watering right through the whole of the roads, the extra cost and consequential damages would be about 5d. per ton?—That is it.

19523. You do only a third of the roads instead of the whole, and therefore the consequential damages there would be about 2d.—about a third?—Yes.

19524. (*Mr. Wm. Abraham.*) That is not what you have said?—That is what I mean.

19525. (*Chairman.*) I should have thought it would not have been nearly as much as 2d., because you say that the consequential damages of watering, if you were obliged to water the whole instead of only one-third of your colliery, would be 5d., but I do not gather at all from your statement that you think the consequential damage of the watering of one-third where the strata can stand it is at all in the same proportion as the watering of the whole?—I quite agree, my Lord; it would not be *pro rata*.

19526. It would be very much less?—It would be very much less than *pro rata*.

19527. (*Mr. F. L. Davis.*) What gave rise to this was that Mr. Abraham said that even with the watering which you do at present, that is in the most favourable places, you still have "pucking" and still get your roads in a bad condition?—Yes.

19528. That is even with the watering that you do now?—Yes.

19529. (*Chairman.*) You put the extra cost at about 2d. per ton; that is your opinion?—That is simply an estimate on the spur of the moment.

19530. Then putting the danger of accidents out of mind altogether, if you did not artificially water the mine at all, but left it as dry as it was by nature, it would save in getting the coal something like 2d. per ton. That is how I understand you to put it?—That is so, my lord.

19531. (*Mr. Ratcliffe Ellis.*) Then 2d. per ton has to be added to the ¾d., or whatever the figure is?—Yes.

19532. (*Mr. Wm. Abraham.*) Then if the 2d. per ton is to be added to the 1¼d. it is 3¼d.?—It is 2¾d. Mr. Cunynghame suggested that if we added interest and every possible figure, it might amount to 1½d. at the most, but the figure I have given is upon the gross output. Upon the large coal output it is pretty nearly 1d. per ton, but taking the gross output of large and small, it is about ¾d.

19533. (*Mr. F. L. Davis.*) 3d. per ton upon your output would be about £15,000 a year?—Yes.

19534. (*Mr. Ratcliffe Ellis.*) The other parts of the mine which are not watered now are parts where the consequences of watering would be much more serious?—Yes.

19535. Therefore the cost of repairs there would be more than the cost of repairs in the other places?—Yes. If you thoroughly watered the whole colliery, the consequential damages would be 5d.; that is the total; you cannot make it more than that.

19536. (*Chairman.*) Added to the 1d., the consequential damage and everything would be 6d. per ton?—That is the extreme; it cannot be more than that.

19537. At present it being only 3d., practically it would be double what it is at present?—Yes; rather more than double.

19538. (*Mr. F. L. Davis.*) Mr. Abraham has asked you with reference to your system of cleaning. I put it to you that you do not know of any system of dry cleaning?—No.

19539. The way in which you clean is that after spraying and damping the roof and sides you clear up the dirt?—Yes.

19540. And you regularly clean the roads, I suppose, for the sake of making your haulage run smoother, and preventing breakdowns?—That is so.

19541. It is to the interest of the colliery manager himself to keep his roads clean?—Yes.

19542. With regard to the screening it has been suggested to you by Mr. Abraham, whether the amount of spraying you do when the journey starts from the face is sufficient to affect the screening of the coal at the top, and whether you find any difficulty in screening the coal afterwards?—We find no difficulty.

19543. The amount of water that you spray on to the tram cannot be very great?—No; it is very small, but it is sufficient to lay the dust.

19544. We had a gentleman here yesterday who did not come from South Wales, but spoke with regard to a different kind of coal. He said that in order to properly damp his coal so as to prevent the dust getting off the trams he had to put 12 gallons of water to 8 cwt. of coal; but then he explained that he could not do that in practice, because when the coal came up to be screened, it being so much saturated as that of course affected the screening of the coal, and the small coal was clogged together and it did not pass through the screen. What I want to arrive at is, that the quantity of spraying which you put on the top of the tram just before it leaves is sufficient in your opinion

Digitized by Google

to damp the top, but it cannot affect the trams of coal at all?—No; there would be very much less than the quantity you mention in the case of that witness.

19545. With regard to a fall of roof in No. 1 pit, which occurred two or three weeks ago, had it anything to do with watering?—Yes, I think it was partly the effect of it, because it is a very wet roadway, and the ground is very small.

19546. (*Mr. Wm. Abraham.*) It is a very wet roadway?—Not naturally wet.

19547. (*Mr. F. L. Davis.*) Will you in as few words as possible explain that fall?—It is on one of our main roadways in the 4 ft. seam where the ground between it and the next seam above is of a very brittle and tender nature. It is a road which has been open for a great many years, and the effect of the atmosphere and dampness in the air has been to pulverise the whole of the ground. About a fortnight ago we had a tram run away from a journey, and it knocked out a pair of timbers and brought down a very large quantity of roof, which completely blocked the airway, with the effect that a certain quantity of gas came down with it and filled the airway for some considerable distance. That fall kept running for about two days.

19548. Will you explain how you went in there, and how your lamps all went out? I wish to show what happened and what was behind the fall. The effect of the fall was to bring down the gas, and it was very difficult to get in on the inside of the fall. There were some horses inside and we were very anxious to get to them, because we thought that possibly the horses might, in kicking the rails or things of that kind, raise sparks which might cause an accident; so that we had to go through 200 or 300 yards of airway which was laden with gas to a certain extent—an inch or an inch and a half of cap—perhaps not quite so much as an inch and a half, but an inch.

19549. That is a class of roof in which with watering that would often occur, or at least a deposit of that kind might every now and then occur. You say that this was a place which was kept damp; what I wanted to ask you was whether this was a fall which might occur to that extent so as to disarrange the ventilation altogether?—Yes.

19550. Fortunately there were no men behind that, but there were only horses?—There were 17 horses.

19551. (*Chairman.*) I understand the primary cause of this fall was the tram running away and the timber started out of place and got dislodged?—Yes, but the ground above was very small and that was the difficulty; we could not keep the ground from running—it was running just like sand.

19552. The accident would not have happened but for that runaway tub, which brought down some of the timbers?—It would not have happened in that particular instance but for that, but it is a very frequent thing to have falls in the course of repairs. In the course of repairing you might knock out a pair of timbers, which would produce exactly the same effect.

19553. (*Mr. Wm. Abraham.*) So that you lay it down now as a theory rather than what has happened as a fact that the extent of falls would be greater where there is artificial watering than they would be if there was not that watering?—Yes.

19554. You lay that down as a theory?—I do, with certain roofs where the watering is generally done.

19555. (*Mr. F. L. Davis.*) Do you know of any cases where explosions have occurred, I will put it presumably, from a spark caused by falling stone in a disused level or a disused mine, or on a day when there was not a single man in the pit?—Yes, I have known of such cases, and we have a case in our own experience where a spark caused an explosion. You will find that case referred to in Mr. Robson's Report for 1892.*

19556. (*Chairman.*) A spark caused by the concussion of one stone falling upon another?—Yes. It was a case where there were a certain number of repairers working upon a roadway, and they had knocked out a pair of timbers. The ground was very uneasy above, and whilst the ground was uneasy the repairers went back on the side of the roadway and had some lunch. Whilst they were away a fall took place, brought down gas, and the two stones falling together caused an explosion which burnt the men. Mr. Robson, who was the Inspector for the district at that time, examined all the lamps, and he eventually agreed, I think, that the cause of the explosion was the spark. If you care to see the reference, I have the Blue Book here.

19557. (*Mr. F. L. Davis.*) Was there not a case at the Ocean Collieries where an explosion took place when there were no men in the pit at all?—Yes; that was on a Sunday, at Maindee. I think Mr. Abraham would know of that case. I think there was also a case at Treharris, which was attributed to the same cause.

19558. I put these questions to you because it is generally considered by Mines Inspectors when accidents have occurred that there must be shot-firing. We have, I think, four or five instances in South Wales of explosions taking place when there were no men in the pit. There was another case of a disused mine?—Yes, there was one in Ystrad, which Mr. Abraham would know about; it is called Church Level. That occurred about 20 years ago; an accident happened there, and caused an explosion, and it was in a disused mine, there being no one in the pit at all.

19559. Do you think the present rules with regard to shot-firing, if properly carried out, are sufficient?—I think so.

19560. With, possibly, the suggestion which Mr. Ellis made?—I think the only suggestion I could make with respect to an improvement in the Shot-firing Rules is that a special man should charge the holes, and that that should be taken away from the colliers altogether, because a collier might not always know the right amount of charge to put in to bring down the ground, and if he overcharges the hole there is always the danger of a blown-out shot, which might be very dangerous.

19561. (*Mr. Smillie.*) These falls which you refer to took place in the 4 ft. seam?—Yes.

19562. What is the seam above it?—The 2 ft. 9 in.

19563. Has it any local name?—It is called the 2 ft. 9 seam.

19564. Is it a fiery seam?—Yes.

19565. What is the distance between it and the other?—Ten yards.

19566. The 2 ft. 9 seam had not been wrought out above the 4 ft. seam at this particular point?—Not at that particular point, I think.

19567. Of course it is natural, especially in a fiery seam, that gas should come down, on such a fall as that happening?—Yes.

19568. Have you known very extensive falls take place in the 4-ft. seam in collieries in South Wales where it was absolutely dry?—Yes.

19569. That is where there was no watering, whether artificial or otherwise?—Yes, I have known such falls.

19570. And this fall might have taken place supposing there had been no water at all?—It might have taken place, it is true, but what I say is that the effect of water is to pulverise it. I think it is self-evident now from the rubbish tips that we see in South Wales; it is all pulverised stuff.

19571. Did you not intend to convey that this fall was caused largely by the place being very wet?—It was moist and damp; it was one of the main roadways.

19572. But it might have taken place if it was absolutely dry?—I agree it might have done so.

19573. It is very natural for falls to take place if timbers run out?—Yes.

19574. Do you know the Abertysswg Colliery?—I know where it is; I have never been down it.

19575. Do you remember an explosion which took place some years ago there?—Yes.

19576. Did you read the report on it?—I did, at the time.

19577. Were you aware that that explosion originated from a very extensive fall—a fall which covered probably 60 or 80 yards at the face?—Yes, possibly.

19578. And it fell from one seam to the other?—Yes, possibly. I do not remember the circumstances, although I remember the accident.

19579. According to the analysis of Ferndale coal dust, the Ferndale coals are free from moisture?—Yes.

19580. It is naturally very dry?—Yes.

19581. I think we may take it that this class of coal in South Wales is the driest class of coal we have in the country?—Yes.

19582. The tubs which you fill contain 30 cwt.?—About that—from 30 to 35 cwt.

* C 6986, IV, 1893.

Digitized by Google

Mr. D. Hannah.

2 May, 1907.

19583. Would 25 per cent. of the coal in a tub such as that be small coal ?—Yes.

19584. About 25 per cent. ?—Yes, but that would not be dust, of course ; it would be "small coal."

19585. (*Mr. F. L. Davis.*) It would be about from 20 to 25 per cent., would it not ?—Yes, about 20 to 25 per cent.

19586. (*Mr. Smillie.*) Could you give me any idea, roughly, what amount of water it would take to so saturate the top of that tub as to prevent dust rising from it ? Would a gallon of water be sufficient to lay the dust on that 30 cwt. tub ?—Yes, I should say a gallon would be sufficient to lay just the surface of it.

19587. If it was properly sprayed over it, a gallon of water should lay the dust on the surface of tha tub ?—Yes.

19588. Would you be afraid that in transit that dust would fall to the bottom and other dry dust rise to the top ? —No.

19589. Have you in your own experience found that such a thing did take place ?—The spraying of the trams is comparatively recent, and we know from experience that it has considerably reduced the quantity of dust as compared with what it was before.

19590. Your haulage roads are of considerable length ? —Yes.

19591. You have no reason to doubt that your spraying is quite effective in preventing dust coming off your tubs ? —No.

19592. You are not afraid that effective spraying of the tubs will lead to disputes between you and your workmen as to the real weight of the coal ?—The spraying of the tub is all in favour of the workmen.

19593. Quite so, but it would not add more than a few pounds to the whole weight of the tub ?—No.

19594. It turns the weight in their favour, perhaps, if it is a question of which way it is, but it does not amount to a cwt. altogether, as was suggested to us by a witness who was called yesterday ?—No, I do not suggest that it does.

19595. You say that it would be absurd to suggest blasting in thin seams where coal-cutting is done by machinery ?—I say in South Wales—I qualify it by that.

19596. Do you know whether blasting is necessary in other districts with coal-cutting ?—That I cannot say ; I have no experience of other districts.

19597. Is there a good parting between the coal and the roof there ?—It is not so much that as the slips in the coal ; they are like layers, and once you undercut the layers come apart, and the application of a bar or of a pick is necessary to bring the coal down.

19598. Have you to do anything to prevent this coal breaking over the top of your machine ?—Yes, occasionally.

19599. You said the small coal kept the coal up ?—Yes, it generally does so. If you remove the small coal away from the cut, then it would be necessary for safety to put in chocks, so as to keep the coal up ; but in practice it is found that the small coal is nearly sufficient, and that the small coal itself serves as a cushion and prevents the coal falling.

19600. You said it would be absurd to suggest blasting this coal in South Wales, because of the nature of the coal there ?—That is so.

19601. But if Mr. Abraham is correct and you are correct, that the nature of the dust there, because of undercutting, is more dangerous where it is required to blast it down, would not that make blasting more dangerous ?—Of course the only thing is that they do not harmonise at all. You say "where it is required," but it is not required anywhere in South Wales.

19602. I am taking it that in South Wales it is not required, but we are dealing with a broader subject than South Wales.—I do not know about other districts.

19603. You may take it from me that I know of collieries in which there are regular shot-firers for bore-holes, and where machinists undercut the coal, and then blast it down afterwards before the men begin to fill it.—Yes.

19604. Given those conditions, that a considerable amount of fine dust is caused by undercutting, and that blasting requires to be done, would it make it more dangerous to blast ?—Yes, in such a case as that it might.

19605. Yours is a very deep undercut ?—Yes, about 5 ft.

19606. And the coal comes down the more easily the further it is undercut ?—Yes.

19607. Your machine is wrought by compressed air ?—Yes.

19608. Do you think it would be dangerous to have electrically-driven machines in your South Wales fiery collieries ?—I should not like to say that definitely now, but I think we want a little more experience, possibly, of the use of electricity for coal-cutting machines. I think the danger arises from the covering in of the cables more than from any fault of the machine.

19609. You say in your statement that you believe an explosion has been caused by a spark caused by two stones striking against each other ?—Yes.

19610. It naturally follows from that that an electric spark might kindle the gas ?—In the presence of gas, yes.

19611. You said that if your pipes burst there might be a danger of flooding the part of the mine where the breakage takes place ?—Yes.

19612. But you do not usually water your roads at night ; it is done during the day, is it not ?—Generally in the daytime.

19613. You have a main tap from which you can turn off your main supply ?—At different points we have.

19614. That could easily be done on a Saturday night to prevent such a thing as a pipe bursting then ?—It is not turned off unless it is absolutely required. Sometimes some pipes get broken and we then turn off the cock and attend to the repairs at once.

19615. As an extra precaution to prevent flooding of your mines on Sundays when nobody is there to look after it, you could turn the cock off at the main pipe ; that could be done ?—Yes.

19616. I understand you to say that you are in favour of the miners being prevented by law from stemming their own shot-holes ?—Yes.

19617. That is where safety lamps are used, and where there is danger, of course ?—Yes.

19618. Do you know of any case in any of your own collieries, or in any other collieries, where the miners blast out their coal from the solid without any undercutting ?—No, I do not know of any instance. We do not do any blasting in coal at all.

19619. Blasting the coal in the solid in a fiery mine would be a dangerous method of coal-getting, would it not ?—Yes. We do not do so at all, for other reasons ; we find the coal is better when it is wrought by hand than it is by blasting it.

19620. But your own experience would lead you to form the opinion that holes bored in the solid in the coal would be more likely to get blown-out shots than when they are undercut ?—When they are right in the solid I should say so.

Digitized by Google

APPENDICES.

Digitized by Google

LIST OF APPENDICES.

APPENDIX.	TITLE.	PAGE.
I.	Analyses of Coal Dust from Courrières and Talk-o'-th'-Hill Collieries -	295
II.	Return giving information as to the Methods of Watering, &c., adopted at the principal Collieries in Glamorganshire.	296
III.	Particulars of Fatal Explosions of Firedamp or Coal Dust during the years 1896 to 1905.	302

Digitized by Google

APPENDIX I.

Analyses of coal dust from Courrières and Talk-o'-th'-Hill handed in by Mr. A. M. Henshaw (*see* Qu. 10,546. pars. 16 and 17).

I

Note on the Courrières Explosion.

This was an extensive explosion of coal dust without the aid of firedamp. Flame traversed upwards of 30,000 mètres of the roadways of four pits, including many of the principal haulage roads and intakes.

The explosion originated at the face of the Lecœuvre heading, in the vein Josephine, north-east of the No. 3 pit.

The plan given on Plate I. shows some of the principal roads in various seams, the path followed by the explosion, and the points numbered 1 to 20, from whence samples of dust, &c., were taken.

The following figures are the results of analysis of the samples:—

—	Carbon.	Volatile Matter.	Ash.
No.	Per cent.	Per cent.	Per cent.
1. No. 3 Pit. Piece of coal taken from the interior of a blown-out shot-hole at the face of the Lecœuvre heading	65·50	29·35	5·15
2. No. 3 Pit. Dust from the floor, near the face of the Lecœuvre heading, which was traversed by flame	67·15	24·00	8·85
3. No. 3 Pit. Dust from the floor of the Josephine main level North 326. Explosion stopped	35·45	22·25	42·30
4. No. 3 Pit. Dust from Josephine airway to top of staple. Explosion stopped	19·60	15·45	64·95
5. No. 3 Pit. Dust from Josephine airway where traversed by flame, and near staple which was used as a "tip" for coal	60·60	30·45	8·95
6. No. 3 Pit. Dust from point near No. 5, also traversed by flame	56·75	26·45	16·80
7. No. 3 Pit. Crust of coked dust adhering to timber in Bowette North 326 at bottom of staple last mentioned	60·50	21·65	17·85
8. Do. 2 Pit. Dust from floor of South Bowette 340, near No. 2 Pit, but beyond the limit of flame, and not traversed by the explosion (main road to Pit No. 10)	25·75	19·65	54·60
9. No. 3 Pit. Dust from Bowette 280 North of No. 3 Pit, not traversed by explosion	38·45	25·55	36·00
10. No. 3 Pit. Dust from Cecile level, which was up to this point traversed by flame, as evidenced by coked dust adhering to timber	45·76	27·37	26·87
11. No. 3 Pit. Dust from same level, 70 yards West of No. 10, at a point not reached by flame. Explosion stopped between Nos. 10 and 11	24·90	15·20	59·90
12. No. 3 Pit. Crust of coked dust from timber in rise road	56·65	18·10	25·25
13. No. 3 Pit. Dust, 4 yards beyond No. 12. Coked dust observed over further 20 yards	44·58	27·42	28·00
14. No. 3 Pit. Dust from same rise road at point not reached by explosion: 40 yards beyond No. 13, and 20 yards beyond furthest coke observed	39·40	22·85	37·75
15. Pits 4–11. Dust from Ame level at bottom of short incline from bottom of Marle staple. Flame traversed the staple and incline to the bottom. Sample collected near, but beyond point where flame ceased	26·50	14·85	58·65
16. Pits 4–11. Dust from Ame level as above, but on West side of incline, near, but beyond, point where flame ceased	29·00	19·20	51·80
17. Pits 4–11. Dust projected and adhering to girder between flanges South Bowette 299, near pit, no evidence of the passage of flame	31·30	21·70	47·00
18. Pits 4–11. Dust from floor near No. 17	36·00	25·90	38·10
19. Pits 4–11. Josephine air and travelling road, not traversed by the explosion	22·40	30·60	47·00
20. Pits 4–11. Josephine airway and travelling road to Pits Nos. 5 and 12. Not traversed by the explosion	42·60	25·00	32·40

The figures show that flame traversed roads where dust contained admixture of inert matter or ash up to 28 per cent. They show also that the explosion was actually stopped where the dust contained from 42·30 to 59·90 per cent. of ash, and apparently in one case—No. 14—where the ash was only 37·75 per cent. This latter place, however, was a *cul-de-sac* and the quantity of dust was small, therefore the deduction is not so clear.

In considering such analyses, other factors must be taken into account. First, the uncertainty of obtaining in small quantity a fairly representative sample. Second, the possibility that the dust after the explosion differs from that existing before, by reason of (*a*) the removal of original dust by the force of the explosive current; (*b*) the deposit of new dust brought by the current; and (*c*) the chemical change resulting from combustion of the dust during the passage of flame, which would, of course, reduce the carbon and volatile matter and increase the ash. In the same way a sample of ash taken a short distance beyond the limit of flame may be altered in character.

At Courrières the passage of flame was easily traced by the abundance of coked dust found on the timbers and other surfaces. It was also very striking that the damage to the roads ceased at, or immediately beyond the limit of flame. The explosion was almost entirely confined to roads along which coal was drawn.

A clear instance of the stopping of the explosion was observed in the South Bowette 326, where the road was wet for 60 mètres between the two Cecile levels. It was from the quarter beyond this point that the 13 men escaped 20 days after the explosion. Many of their comrades were killed by after-damp in seeking to escape.

II.

Note on the Talk-o'-th' Hill Colliery Explosion.

This explosion occurred on the 27th May, 1901. It was caused by a gobfire and consequent ignition of firedamp in the Eight-feet Banbury workings, and was extended by coal dust throughout practically all the haulage roads of four seams, but none of the return airways.

A number of samples of dust were collected and analysed. The results are shown in the following figures:—

—	Carbon.	Volatile Matter.	Ash.
No.	Per cent.	Per cent.	Per cent.
1. Dust from floor of lower Eight-feet level, traversed by flame	40·42	29·33	30·25
2. Dust from timber and sides of road same place as No. 1	45·15	26·60	28·25
3. Coked dust, Eight-feet level, from flanges of a girder in roof. Out-bye side	36·05	9·00	54·95
4. Coked dust from same girder. In-bye side	24·90	13·95	61·15
5. Dust from heap deposited by current of explosion on side of Seven-feet level. Traversed by flame	41·35	29·05	29·60
6. Dust from floor of stone drift—haulage road between Seven-feet and Eight-feet seams. Traversed by flame	50·30	25·35	24·35
7. Dust from Seven-feet main level Out-bye of Shaws' dip. Traversed by flame	45·00	27·80	27·20
8. Dust from floor of Seven-feet level at bottom of Shaws' dip. Traversed by flame	48·45	27·55	24·00
9. "Narrow band" of dust on post same place as No. 8	43·90	24·35	31·75
10. Dust from Seven-feet level between Shaws' and far-end dips. Traversed by flame	45·93	29·92	24·15
11. Dust from Seven-feet level. Explosion stopped	33·90	21·37	44·73
12. Dust from Smith's drift in Shaws' dip. Traversed by flame	45·62	29·68	24·70
13. Dust from Shaws' dip. (Much shale due to road repairs.) Explosion stopped	20·50	18·45	61·05
14. Dust from Far-end dip. Explosion stopped: or possibly stopped on level by dust similar to No. 11	36·85	24·15	39·00
15. Dust from Far-end dip. No explosion	37·00	21·50	41·50
16. Dust from deep airway. (Explosion was arrested at No. 11)	55·15	30·10	14·75
17. Dust from deep airway, Out-bye of No. 16. No explosion	47·13	26·50	26·37
18. Paskins' level. Flame entered the road, but was stopped by non-inflammable quality of dust	7·70	15·60	76·70

The figures show that roads which contained dust with ash up to 31·75 per cent. were traversed by flame. The explosion was stopped where the dust contained 44·73 per cent. of ash (No. 11), and possibly by 39·00 of ash (No. 14).

The explosion was stopped near the end of the "old south return" by the naturally wet state of the road over a length of 70 yards. Beyond the wet place the road appeared to be sufficiently dusty to have extended the explosion, having not long been discontinued as a haulage road. This road was directly opposite the stone drift from the Eight-feet seam, and in which drift the greatest evidences of force were observed it being the main route of the explosion.

The explosion was also stopped at the downcast pit bottom, which was wet for 30 yards, and dusty on each side approaching the wet part. Flame failed to cross this, and the dynamic effects also ceased. On the other side of the wet place two doors were blown out; no damage was done to the road, and five horses in a stable were uninjured.

Digitized by Google

APPEN

RETURN giving information as to methods of watering adopted at th

Number of Company.	To what extent is watering done?	Describe different systems in operation.	Different kinds of "sprays" in use, and how far apart.	If the "Man and Hose" system is adopted, how far apart are stand pipes fixed for attaching the hose?	How often do you consider it necessary to water the same length of roadway by the hose system?	Length of pipes in use.	Number of persons required to attend to watering.	Which of the foregoing systems do you prefer, and for what reasons?	Have you sufficient water for watering roadways all the year round?
	1	2	3	4	5	6	7	8	9
1	The whole of the main roadways are watered daily.	"Man and Hose" system.	No "sprays" in use.	The stand pipes are fixed on average of 40 yds. apart.	Once daily.	8,265 yards	Three.	"Man and Hose" system preferred, because it is at all times more reliable than the "spray," which often becomes clogged.	Yes.
2	On all main hauling roads.	The headings near the face are watered by means of casks put in trams and drawn by horses along roads.	The sprays are made by Bell & Co, from a design of Mr. Hopking King (late mechanic to this company), which are fixed about 30 yds. apart.	The stand pipes are fixed 30 yds. apart, to which a spray is fixed. When the waterman comes around, they take off the spray & attach hose pipe.	Every other day on the main roads.	9,129 yds.	Five for main roads.	"Man and Hose" system, as the work is done more thoroughly, as the hose can reach a greater height and width, and so remove the dust from the top of timber and from crevices better.	Yes.
3	We water all our main haulage roads as well as inside where we think necessary.	We use an iron tank at the bottom of which is a valve controlling the water running into a spraying pipe about 3 ft. long at one end.	We use no sprays except the above.	We adopt the "Man & Hose" system, and our standard pipes are fixed about every 40 yds.	About twice a week.	13,910 yds.	Four.	I prefer the system we adopt, as it is more satisfactory. With our method there is always a man responsible for the work done (except the officials), with the other ways it is not always so.	Yes.
4	Very considerably both on main roads and in-bye.	We have no travelling tanks attached to the journeys, but the main roads are watered by hose from stand pipes. Out-bye the D. partings we have pipe sprays, and under arched roads we have Collier's centrifugal sprays. In-bye this double parting we water by casks.	The sprays out-bye the D P are bent pipes with holes in sufficient to water the top of each tram in passing. The sprays under the arched roads are Collier's patent centrifugal sprays, fixed near the crown of the arch. We have these no fixed distances.	From 40 to 50 yds.	Every other day if possible. Every day on pit partings.	17,200 yds.	Four.	The hose system has proved to be the best generally. The centrifugal sprays are also very serviceable as the air is permeated with moisture for over 100 yds. from spray The jet system proved a failure owing to clogging up. The hose system can be used also judiciously on timbered headings, fetching down the dust hanging on the timber.	Yes.
5	Main haulage roads and all other dusty roads.	Beyond the main haulage roads, headings and stalls where required are watered by water casks. Mechanical iron tanks are now on order and, in future, the watering of the above area will be done by these.	No sprays in use.	The "Man and Hose" is in use on all our main haulage roads. Stand pipes are fixed 50 yds. apart.	Every third day.	4,410 yds.	Two men watering and one repairing.	We prefer the "Man and Hose" system. The watering is more thoroughly done.	Yes.
	All main haulage roads.	Pipes and hose.	A number of different types have been tried and used, but have been gradually abandoned.	20 yds. apart.	Some roads every day and some roads every other.	13,600 yds.	Seven.	Hose pipes.	Yes.

Digitized by Google

DIX II.

rincipal collieries in Glamorganshire (*Handed in by Mr. David Hannah.*)

the supply rom lodgeroom r surface ater?	What would be the average pressure of water at the pit bottom?	Do you approve of watering roof, floor and sides?	To what extent does the water damage the roof, floor and sides?	State in what seams watering the roof, floor or sides would cause damage or make it impracticable to water, and state nature of the difficulties in consequence.	Where shot-firing takes place, what is the system adopted for watering to comply with General Rule 12, Sub-section H. (1)?	Are you of opinion that dangers might be caused to horses and men by watering roads of steep gradients?	Do you consider that watered zones, consisting of a length of archway from 100 to 150 yds., built on the main ways of a colliery and kept constantly watered, would have the effect of preventing an explosion passing such zones, or of diminishing its effect if it did pass such zones?	Do you find that dust gets down the pits from the screens to any appreciable extent, and can you advise any system that can be adopted to prevent this?	Along main engine ways, do you adopt what is known as the "Gray Spray"?
10	11	12	13	14	15	16	17	18	19
om lodgeroom.	455 lbs. per sq. in.	Yes.	To a large extent.	In seams of cliff top it causes damage to the roof and sides, and in seams of fireclay-bottom damage to the floor, the floor and sides crushing badly and the floor "pucking" after being watered in these seams.	"Man and Hose" system for a distance of over 20 yds. each way from the place where the shot is to be fired.	Yes.	Yes.	Yes; the screens should be a greater distance from the down-cast pit.	Yes; we have adopted it.
om lodgeroom.	600 lbs. per sq. in.	Yes.	When first put into operation, the watering did a great deal of damage, but now we cannot say that we find it does any great damage.	No. 1 seam. This roof is very bad, and until it is well timbered, watering roof and sides cannot be done, as they would crumble off, and we should have very heavy falls.	"Man and Hose" system.	Yes; as the ground is made very slippery.	All main roads should be thoroughly watered, and that water zones will not be sufficient.	Yes; dust does find its way down the shaft in large quantities from the screens. It could be remedied to a great extent if fine sprays were put up from the pit's mouth to the screens, picking belts, &c.	No.
om lodgeroom.	350 lbs. per sq. in.	Depends upon the kind of strata. With cliff R. & S.—No. With rock R. and S.—Yes.	Depends upon strata again. In cliff, a deal of damage is caused in making it crumble and fall into the roadway. In rock there is very little damage.	The strata of floor, roof and sides vary in the same pit, and in the same seam very often; but I consider that where these are either cliff or shale, damage is always caused by contact with water, thereby making the roads very dirty and very often causing large falls, with the consequent danger of blocking the air.	"Hose and Man" syatem (20 yds.)	Yes; both would be liable to slip a good deal.	Would certainly diminish effect.	Dust undoubtedly goes down the shaft from the screens, but it all depends what distance the screens are from the pit. A small fan is sometimes used at the screens for collecting this dust.	No
om the lodge-om.	From 200 lbs. per sq. in. (in one pit) to 460 lbs in the deepest pit.	Where conditions are favourable, Yes. The first application brings on creep, but after the floor becomes sodden, we do not find the creep trouble us. To water the roof and sides where not timbered is delicate work, and requires to be handled very carefully.	Roof and sides of some seams are very liable to damage; others do not seem to be affected so much. Floor very little damaged, if any.	4 and 6 ft. seams are the worst. The strata is more friable, and, after watering, seems to work as if of lime. As above said, we have very little trouble with floors.	By cask with hose attached. We carry the water as near the face as practicable.	Most decidedly so—so much, that we have been compelled to suspend watering on such roads.	No.	Since the removal of the coal tipping at our No. 2 pit from the pit shed to the new screens some distance off, we have found the character of the dust on our auxiliary in-take much coarser, as if the dust now is only that blown off the trams in the cage.	We have them just out-bye the D. partings only.
rect from sur-ace.	Head of water 460 and 800 ft.	Floor regularly. Roof and sides where required.	Too difficult to answer. If adopted regularly upon roof and sides where same are bad.	In all seams except when the roof and sides are medium (particularly) in our present state of things, 4, 6 and 7 ft. and yard seams.	In accordance with Rule.	Yes.	Had no experience in this matter.	No.	No.
rface.	530 to 620 lbs. sq. in.	The floor certainly, but the roof and sides can only be treated with care and to a limited extent.	The floor heaves. Watering roof and sides dangerous in some places.	All our steam coal seams are in measures which are affected seriously by watering.	No shots fired in our steam coal seams.	Certainly.	Might prevent an explosion, but would not like to rely upon them. No effect on "after-damp" passing.	Yes. We provide a water spray at the top of the down-cast.	Yes.

Digitized by Google

APPEN

RETURN giving information as to the methods of watering adopted at th

Number of Company.	To what extent is watering done?	Describe different systems in operation.	Different kinds of sprays in use, and how far apart.	If the "Man and Hose" system is adopted, how far apart are stand pipes fixed for attaching the hose?	How often do you consider it necessary to water the same length of roadway by the hose system?	Length of pipes in use?	Number of persons required to attend to watering?	Which of the foregoing systems do you prefer, and for what reasons?	Have you sufficient water for watering roadways all the year round?
	1	2	3	4	5	6	7	8	9
7	All haulage roads, double partings and pit bottoms.	"Man and Hose" and spray.	Ordinary jet placed 20 yds. apart.	40 yds.	According to conditions.	15,400 yds.	Four constantly Watering also done by hanliers with tanks.	Hose system, as the wateriag can be more thoroughly done, as the streams of water can be directed into odd corners and dangerous portions of the roof, and sides can be left undisturbed. In arches some form of spray is preferred, because there is a constant moistening going on and the fine coal dust suspended in the air, is caught. The spray is better to reduce temperature—the moisture is spread and no pools formed.	Yes.
8	Waterering throughout the colliery.	Casks for isolated places.	We use a small brass tap with a pin hole, which causes a fine spray, and which are fixed on stand pipes in the main in-take and return. Distance varies from 50 to 80 yds. We also use a hose with Zones' patent nozzle.	40 to 50 yds.	Two or three times every day.	1,500 yds.	Two.	We prefer the "Man and Hose" system, as we find that when there is not sufficient velocity, and the water is not carried along any distance to be effective, the fine spray is adopted.	Yes.
9	All main haulage roads & where shot-firing.	Tubs and casks for watering stall roads and headings where there are no other means of watering by hose pipe or spray.	Martin & Turnbull's patent compressed air and water sprays are in use, and where used, sprays are fixed from 40 to 80 yards apart. Water Sprays are also used where sufficient clean water with high pressure is obtainable, and are fixed 40 to 80 yds. apart.	About 40 yds. apart	Once a day. Where shot-firing is done—twice.	31,155 yds. (4 collieries.)	Twenty-four.	Compressed air and water where applicable is the best system—all parts being thoroughly moistened without causing pucking to the floor. Standard and hose, 40 yds. apart, give very little trouble to keep in order.	Yes.
10	Very limited extent.	Special water tanks. Pipes are now being laid.	Not given.	Every 40 yds.	Every third or fourth day.	Pipes are now being laid.	Not given.	"Man and Hose" system.	Yes.
11	Hauling roads are watered, and dry and dusty places before shot-firing. "Sprays" are used to water full trams.	Lines of pipes with hose attaching ("Man and Hose"), tanks and casks on wheels with perforated pipes, also casks with hand rotary pumps.	Perforated pipes at double partings and single jet nozzles	20 yds.	About every second day.	3,000 yds.	Six.	For main roads, line of pipes with "Man and Hose," and this we think is the best system.	Yes.
12	All our main roads are regularly watered.	Water tanks with perforated pipes travelling in the engine journey and by horses into horse roads with water brought into the district in pipes. Pipes and sprays on all main roads, also use hose in places.	Gun-metal plug perforated about 15 yds. apart generally. Have tried "Collier's" patent spray, but find they give out too much water.	The sprays can be drawn off and hose pipe fixed on.	Where we use it, we water every day.	15,000 yds.	Including repairs (putting in pipes, &c.), about 6 men.	Sprays and standpipes, because water is ensured more regularly.	Yes.
13	Our collieries are naturally wet.	The "Hose System" and ordinary water tanks.	No sprays in use.	40 yds. apart with hose 20 yds. long.	Once a day.	5,000 yds (these are pump columns, and are used for "Man and Hose" watering where roads happen to be dry.	Two men with hose and four men watering with casks, where necessary.	Hose system, as it is much more satisfactory.	Yes.

Digitized by Google

DIX II.—*continued.*

rincipal collieries in Glamorganshire.—(*Handed in by Mr. David Hannah.*)—*continued.*

s the supply from lodge-room or sur-face water?	What would be the average pressure of water at the pit bottom?	Do you approve of watering roof, floor and sides?	To what extent does the water damage the roof, floor and sides?	State in what seams watering the roof, floor or sides would cause damage or make it impracticable to water, and state nature of the difficulties in consequence.	Where shot-firing takes place, what is the system adopted for watering to comply with General Rule 12, Sub-section H. (1)?	Are you of opinion that dangers might be caused to horses and men by watering roads of steep gradients?	Do you consider that water zones consisting of a length of archway from 100 to 150 yds., built on the main ways of a colliery and kept constantly watered, would have the effect of preventing an explosion passing such zones or of diminishing its effect if it did pass such zones?	Do you find that dust gets down the pits from the screens to any appreciable extent, and can you advise any system that can be adopted to prevent this?	Along main engine ways, do you adopt what is known as the "Gray Spray"?
10	11	12	13	14	15	16	17	18	19
erface.	450 lbs.	Yes: if conditions permit.	Breaks up roof and sides and floor.	Watering has the effect of working the ground, causing it to break away and fall.	Water tanks.	Yes.	Yes: we believe it would have a good effect, but much depends upon the violence of the explosion.	The screens to be removed as far as possible away from downcast.	Yes.
odgeroom.	140 lbs.	Yes.	Watering to a great extent causes the floor to puck and sides to melt.	In seams having soft roofs and fire-clay bottom.	According to Act.	Yes.	We are of opinion that the blast would be diminished.	This being a new colliery and only having just commenced tipping coal, we cannot, therefore, say what result may be later.	No.
odgeroom and pump columns.	From 120 to 300 lbs.	In hard rock—yes. In cliff, clay or shale ground—not always.	In some seams with clay floors it causes heavy puckings. Roof and sides give trouble by melting or slacking, causing falls.	In the 9 ft. seam and seams with weak clay and cliff roofs, watering the roof and sides gives trouble, due to slacking, although watering the floor gives little or no trouble. In the little vein seam and seams with soft clay floors, cause damage where watered, but not always impracticable.	Stand pipe and hose, or by water casks.	Yes.	Such zones probably would stop or diminish its effect, depending upon the length of the wet zone and the force of the explosion.	Not to any appreciable extent.	Yes.
odgeroom.	150 lbs.	Yes.	Not given.	Not given.	By sprinkler attached to tank and by buckets.	Yes.	Yes.	No. our shafts are very wet.	No.
From garlands in pit.	About 180 lbs. per sq. in.	Yes: but only to such an extent as to keep the dust moist.	It causes the roof floor and sides to break and heave, and is a continual source of danger.	All seams according to varying depths and temperature.	A cask or tank with rotary pump worked by hand, with hose attached.	Yes.	Unable to say.	Yes: where screens are near shafts.	Yes. The full trams are watered as they leave the double parting.
From surface.	400 to 500 lbs.	No: only floor.	Causes the floor to puck in places if it is over-watered. Causes the sides to fall in, and bring down the roof. If watered on sides and roof, would cause places to close entirely.	Practically all our seams, wherever there is a cliff roof.	Water tanks in road and watering pots where tanks cannot go.	Yes: we have places where we cannot water for this reason.	Yes.	No: screens are about 70 yds. from the pits.	Yes.
From pump columns.	50 lbs. per sq. in. in column.	Yes: in certain seams.	Weakens the roof and sides and causes the floor to puck.	In all seams except 4 ft. The watering of the roof would cause damage to the extent of rendering the roadway dangerous.	Water tanks or hose.	Yes.	Very probably.	No.	We have tried the "Gray Spray" and discontinued its use.

Digitized by Google

APPEN

RETURN giving information as to the methods of watering adopted at the

Number of Company.	To what extent is watering done?	Describe different systems in operation.	Different kinds of "Sprays" in use, and how far apart?	If the "Man and Hose" system is adopted, how far apart are stand pipes fixed for attaching the hose?	How often do you consider it necessary to water the same length of roadway by the hose system?	Length of pipes in use?	Number of persons required to attend to watering.	Which of the foregoing systems do you prefer, and for what reasons?	Have you sufficient water for watering roadways all the year round?
	1	2	3	4	5	6	7	8	9
14	Main haulage roads, main headings and returns.	Sprays, ordinary casks and special water tanks mechanically controlled.	Ordinary sprays from 40 to 45 yds. apart.	About 50 yds. apart.	12 to 36 hours.	26,400 yds. in three pits.	15.	The mechanically controlled tank.	Yes.
15	Main haulage roads are watered by means of pipes and hose. Stall roads are watered by means of water carts.	Water pipes are laid along main roadways. Pit-bottom sidings are watered by means of sprays.	Sprays of a German make, with a fine nozzle, 40 yds. apart.	40 yds.	Once in 24 hours. In lower 5 ft., three times in 24 hours.	17,698 yds.	23.	"Man and Hose" for roadways, with the addition of sprays in the pit-bottom sidings, where arched.	Yes.
16	Most of the main haulage roads, which are not naturally wet are watered.	Watering by hand with hose by means of sprays & Creeds' patent watering tank.	We use Korting sprays and Collier sprays to a small extent, about 50 yds. apart.	50 yds. apart.	Every day.	Not given.	Not given.	"Man and Hose" system	Yes.
17	Water pipes are fixed and watering is done by this means.	Mechanical haulage road is by a hose. We use tubs with the journeys.	We have tried many kinds of sprays, but not successfully.	About 20 yds. apart, and the man carries about 8 to 10 yds. of hose.	Every other day. Partings near the shaft are watered night and morning.	54,887 yds. (4 collieries).	31.	"Man and Hose" system.	Yes.
18	Main roads by pipes laid from lodge-room in pit to inner double parting branch roads, where conditions allow, by tanks. Places where shots are fired by either hose or casks.	On roads where pipes are not laid, and which require watering, iron tanks holding 180 gallons of water and fitted on wheels are taken. A hole fitted with plug allows water to flow into roads. Casks are taken to places where shots are fired, and the water thrown on roof, floor and sides by buckets.	Two kinds of sprays in use.— (1) Those fixed on pipes laid along roadways. The distance apart depends upon how far each spray can effectually water, and this depends on pressure of water in pipes at that point, and strength of air current. Distances vary from 15 to 40 yds. (2) "Gray Sprays." This is a pipe carried over the road at the outer end of the double parting, having holes on the under side, through which water is played upon the full trams when leaving the parting.	This system is generally adopted at these collieries. The stand pipes are fixed every 40 to 50 yds. The Waterman carries a 20-yd. length of ½ in. rubber hose.	Once a day is found sufficient.	45,760 yds. (8 collieries).	35.	"Man and Hose" system.	Yes.
19	All haulage roads that are dry and dusty.	"Man and Hose" casks and a few Collier's sprays.	The single hole spray. Collier's patent spray. A bent ½ in. pipe, perforated with very fine holes.	About 40 yds. apart.	Once every day.	17,910 yds. (5 collieries).	12.	"Man and Hose" watering can be more thoroughly done.	Yes.

Digitized by Google

)IX II. —*continued.*

rincipal collieries in Glamorganshire (*Handed in by Mr. David Hannah.*)—*continued.*

the supply om lodgeroom r surface ater?	What would be the average pressure of water at the pit bottom?	Do you approve of watering roof, floor and sides?	To what extent does the water damage the roof, floor and sides?	State in what seams watering the roof, floor or sides would cause damage or make it impracticable to water, and state nature of the difficulties in consequence.	Where shot-firing takes place, what is the system adopted for watering to comply with General Rule 12, Sub-section H. (1)?	Are you of opinion that dangers might be caused to horses and men by watering roads of steep gradients?	Do you consider that water zones consisting of a length of archway of from 100 to 150 yds., built on the main ways of a colliery and kept constantly watered, would have the effect of preventing an explosion passing such zones or of diminishing its effect if it did pass such zones?	Do you find that dust gets down the pits from the screens to any appreciable extent and can you advise any system that can be adopted to prevent this?	Along main engine ways, do you adopt what is known as the "Gray Spray"?
10	11	12	13	14	15	16	17	18	19
dgeroom.	500 lbs. per sq. in.	No roofs at this colliery will stand watering, and in some cases the sides will not take much, while the over-watering of floors also gives trouble.	The roof and sides crumble by watering, and it also causes upheaval of the bottom.	All the steam coal seams.	Tanks and buckets.	Yes.	We think that an archway thoroughly watered is enough to prevent an explosion passing.	No doubt a portion of the dust goes down the pits, but this can always be prevented by making an archway to the pit on the opposite side to the screens through which all air would pass.	On the suggestion of Mr. Robson, late Inspector of Mines, we adopted this system nearly 16 years ago, and has been in operation ever since with very beneficial results.
rface.	520 lbs.	Not in all cases. A few sprays are useful where the roof is heavily timbered.	Affects the floor causing it to lift badly in places.	Watering in 5 ft. seam causes a continued squeeze.	Tanks are taken into the various roads where shot-firing takes place, and the water thrown on the roof, floor and sides by buckets.	Yes.	It would probably diminish the effect of an explosion.	Yes.	Yes.
dgeroom.	100 lbs.	No.	In some seams it would be impossible unless the roadway is arched, as it would cause large falls.	4 ft. seam. 6 ft. seam. 7 ft. seam. 9 ft. seam.	If there are no water mains, the place is watered by Creed's patent water tanks.	Yes.	Yes.	Where screens are very close to downcast pit.	No.
mp column.	280 lbs., 550 lbs., 175 lbs. 337 lbs., and 337 lbs. (4 Mines).	This depends entirely upon the roof and sides.	The only roof and sides that will stand watering is sandstone rock. Clifts and shale will not stand watering.	I do not think there is any seam where roof or sides could be watered universally.	Permitted explosive and watering.	Yes.	In many instances a water zone would probably prevent an explosion, which was a dust explosion, extending far beyond the zone.	Not to any great extent.	Yes.
dgeroom. Supplemented by rface water at os. 2 and 4 its in summer onths, where ie lodgeroom ecomes dry.	300 to 400 lbs. sq. in.	Where the strata is of such a nature to allow this being done without causing falls and much heaving of the floors. Where the gradients are heavy and trams are hauled by horses, it becomes dangerous, as the horses cannot control the heavy trams on greasy rails caused by watering.	Depends upon the nature of roof, floor and sides.	The 4 ft. seam in this district is particularly bad in this respect.	In some districts 1 in. pipes are laid from the main column on haulage roads up the headings, having taps at the entrance of each stall to which a hose-pipe can be fixed. When this is done, the roof, floor and sides in the neighbourhood of the shot are watered by hose. Where this cannot be done, casks of water are taken to the place, which is then damped by means of a bucket.	Yes.	Water zones are quite a recent suggestion as having the effect of preventing or diminishing the force of an explosion, and I could not say with any degree of certainty that it has had this effect, but I am of the opinion that if it did not prevent the passage of an explosion, it would considerably diminish its after-effect.	A certain amount no doubt does, but in pits that are wet, such as Ferndale, I do not think that it travels far from the pit bottom. The only practical prevention for this being to keep the screens as far from the pit top as possible, to close all openings from sidings to the pit, and to spray the coal when being tipped on screens.	Yes.
rface and dgeroom.	140 to 300 lbs. per sq. in.	Yes: when it can be done with safety.	It damages roof, floor and sides.	2 ft. 9 in. seam. 6 ft. seam. 7 ft. seam. One of the new seams.	Casks and small buckets.	Yes.	Yes. I am of opinion that if the above length of archway, well built and packed, is kept thoroughly and constantly wet all round, it would diminish the fire of an explosion, if not altogether preventing its passage through such zones.	Not to any appreciable extent.	No.

Digitized by Google

APPENDIX III.

Particulars of Fatal Explosions of Firedamp or Coal Dust during the years 1896 to 1905.

NOTE.

The attached particulars of fatal explosions of firedamp or coal dust during the period of ten years from 1896 to 1905 have been compiled from the Annual Reports of the Inspectors of Mines and from the Special Reports on the particular explosions.

The total number of Explosions and deaths during that period were :—*

Year.	Number of Explosions.	Number of Deaths.
1896	25	173
1897	12	19
1898	12	27
1899	23	54
1900	25	45
1901	21	125
1902	23	63
1903	11	14
1904	17	22
1905	14	178
Total	183	720

During the same period the total number of deaths from all classes of accidents was 10,202, which were made up as follows :—

Explosions of firedamp or coal dust	720
Falls of roof and side	4,793
Shaft accidents	727
Accidents with explosives	244
Haulage accidents	1,828
Other accidents underground	623
Surface accidents (including sidings)	1,267
Total	10,202

* A fuller table giving the number of both fatal and non-fatal explosions, arranged according to Inspection Districts will be found in the Minutes of Evidence, Vol. 1, Appendix V., p. 360.

Digitized by Google

For the purposes of classification, letters have been placed at the end of the remarks on each explosion, showing the ascertained or supposed cause, and the following table gives a summary of these groups :—

Cause.	Number of Explosions.	Number of Deaths.
Unprotected lights (*A*)	119	253
Other naked lights, *e.g.* matches (*B*) ..	12	25
Safety lamps, defective or opened (*C*) ..	17	88
Shot-firing (*D*)	29	334
Miscellaneous (*E*)	6	20
Total	183	720

Out of the total number of explosions for the whole period the influence of coal dust in extending the explosion was remarked in 21 cases according to the Reports. These, however, included, as might be expected, the more serious explosions and the death-roll was accordingly high, amounting to a total of 476 out of 720 deaths.

In the attached table these figures have been classified for each Inspection District.

Royal Commission on Mines,
31, Great George Street,
Westminster, S.W.

(P.T.O.

Digitized by Google

Table showing for each Inspection District the number of Fatal Explosions of Firedamp or Coal Dust, classified according to cause, for the years 1896 to 1905 :—

CAUSE.	East Scotland.		West Scotland.		Newcastle.		Durham.		Yorkshire and Lincolnshire.		N. & E. Lancs. and Ireland.		Liverpool.		Midland.		North Stafford-shire.		South Stafford-shire.		South Western.		South Wales.		Totals.	
	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.
Naked lights (*A, B, C*)	15	19	23	31	5	9	1	1	5	68	1	3	2	10	2	3	—	—	11	14	1	1	14	46	80	205
Shot-firing (*D*)	3	7	5	13	3	3	3	28	1	3	—	—	—	—	—	—	—	—	—	—	—	—	1	57	16	111
Miscellaneous (*E*)	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2
Extended by coal dust (*F*)	1	3	3	17	—	—	2	26	1	63	—	—	—	—	—	—	—	—	—	—	—	—	3	81	10	190
Totals (*A, B, C, D, E*) ..	18	26	28	44	8	12	4	29	7	73	1	3	2	10	2	3	—	—	11	14	1	1	15	103	97	318

CAUSE.	East Scotland.		West Scotland.		Newcastle.		Durham.		Yorkshire and Lincolnshire.		N. & E. Lancs. and Ireland.		Liverpool and North Wales.		Midland.		Stafford.		Cardiff.		Swansea.		Southern.		Totals.	
	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.	Number of Explosions.	Number of Deaths.
Naked lights (*A, B, C*)	11	17	16	20	5	8	3	3	5	5	1	4	—	—	2	5	9	13	9	52	5	16	2	18	68	161
Shot-firing (*D*)	—	—	—	—	3	4	—	—	2	2	—	—	3	7	—	—	1	1	3	208	1	1	—	—	13	223
Miscellaneous (*E*)	—	—	1	2	—	—	—	—	—	—	—	—	2	11	—	—	1	4	—	—	1	1	—	—	5	18
Extended by Coal dust (*F*)	—	—	—	—	1	1	—	—	—	—	—	—	1	4	—	—	2	5	5	249	1	11	1	16	11	286
Totals (*A, B, C, D, E*) ..	11	17	17	22	8	12	3	3	7	7	1	4	5	18	2	5	11	18	12	260	7	18	2	18	86	402

Digitized by Google

Particulars of Fatal Explosions of Firedamp or Coal Dust during the years 1896 to 1905.

NOTE.—*The letters placed after the description of each accident are for purposes of classification according to cause, and signify :— A, unprotected light ; B, other naked lights, e.g., matches ; C, safety lamps defective or opened, &c. ; D, shot-firing ; E, miscellaneous or doubtful ; F, explosion extended by coal dust.*

No.	District.	Number of Deaths.	Remarks.
	1896.		
1	East Scotland	1	(Oil shale mine.) Ignited firedamp with naked lamp improperly carried along with a safety lamp when making the statutory inspection before a shift. Inspector states not caused or complicated by coal dust. (*A*)
2	„	1	Ignited firedamp at face by an open light. Inspector states not caused or complicated by coal dust. (*A*)
3	„	2	Ignited firedamp on longwall road where they were redding a fall and using naked lights. Inspector states not caused or complicated by coal dust. (*A*)
4	West Scotland	1	Ignition of firedamp accumulated in stooped waste by naked light, on miner entering his place. (*A*)
5	„	1	Entered with naked light disused workings which had not been inspected. (*A*)
6	„	1	Firedamp ignited at a naked light when men entered their places in the morning. (*A*)
7	„	1	Naked light ignited firedamp after firing a shot. (*A*)
8	„	1	Naked light ignited firedamp on miner entering working place. (*A*)
9	Newcastle	2	Explosion of gas, owing to the men going into the place, one with safety lamp and one with a naked light. Inspector states that seam was a wet one, otherwise the consequences might have been more serious. (*A*)
10	„	1	Explosion of small quantity of gas on top of a fall of clay caused by naked light. (Conviction for failing to use safety lamps followed.) (*A*)
11	„	1	Explosion of gas, caused by naked light ; gas had accumulated in hole in roof caused by a fall. (*A*)
12	Durham	20	(Brancepeth.) Shot-firing on main engine way. The evidence went to show that one of the deceased, without authority, had fired a shot of compressed gunpowder in order to remove a projecting stone. The improper position of the hole produced the effect of an overcharged shot. The shot ignited the coal dust and caused an explosion, causing the deaths of 20 persons. There was no evidence of firedamp being present. The mine was not considered dry or dusty, but there was evidently sufficient dust to cause an extensive explosion. A certain amount of watering was carried out to keep the roads in good order, but this was insufficient to stop the explosion. (*D, F*) *
13	Yorkshire and Lincolnshire.. ..	1	Naked light. Explosion of firedamp in working place. (*A*)
14	„ „	63	(Micklefield.) Naked lights were in use at the colliery, and the conclusion was that a small quantity of firedamp, ignited at a naked light, set up an extensive dust explosion. Firedamp had only been found at rare intervals during a period of 23 years. The amount of dust was believed to be inconsiderable, as the coal was hard ; dust from the floor had been removed, and the floor watered with water-tubs at irregular periods. The last occasion of watering was about a fortnight before the explosion. Open tubs were in use. After the explosion precautions were taken for the complete watering of the mine, and safety lamps were introduced. (*A, F*) †

* Reports by Mr. Joel and Mr. Bain. C. 8,174, 1896.

† Reports by Mr. Thomas and Mr. Wardell. C. 8,175, 1896.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1896—*continued.*		
15	South Stafford	1	Caused by a naked light. Explosion of firedamp in a "blind end" on men entering their places after being absent for meals. Neglect of examination by safety lamp as required by Special Rule. Ventilation of "blind end" inadequate, and fireman subsequently convicted and fined. (*A*)
16	„	1	Man went into other men's working places with a naked light after they had left, when some firedamp which had accumulated there exploded. Breach of Special Rule by leaving his own place of work. (*A*)
17	„	1	Man sent into the next working place, and fired an accumulation of firedamp. Naked light. Manager convicted and fined for breach of General Rule 4, in not observing station, and appointing an incompetent person. (*A*)
18	South Wales	2	Explosion at an unbonneted Clanny lamp, while attempting to remove an accumulation of firedamp. The precautions taken were inadequate. (*C*)
19	„	57	(Tylorstown.) The explosion was probably caused by the firing of a shot (permitted explosive) in gas in a stall. The gas was ignited either by the shot, which was partially blown out, or possibly by the sputtering of a tape fuse which had been substituted for electric firing some weeks before the explosion; the far-reaching effects of the explosion were due to coal dust. There was reason to believe that the place had not been examined for gas by the fireman, who lost his life, and the practice with regard to watering before a shot was not found to be satisfactory in every respect. Safety lamps were in use, and provision was made for watering the roadways by an extensive system of pipes and sprays, and beyond the reach of pipes by water-casks. A wet condition of the floor was thus secured but the sides and the roof remained dry and dusty. As to the watering of the place where the shot was fired it appeared that it had been watered on the Saturday evening, but the inspector considered it would be quite dry by the Monday morning when the explosion occurred. (*D*, *F*) *
20	„	1	Going into an old stall in search of "cog-sticks" and igniting with his open light some accumulated firedamp which was not known to exist. The old stall was fenced off. Deceased was supplied with sufficient timber, and ventilation was adequate. (*A*)
21	„	1	Ignition of gas by naked lamp. Fireman sent deceased to building a stopping at mouth of top hole, where gas had been found, and cautioned him against going to the face; the latter disobeyed instructions. (*A*)
22	„	3	Explosion of firedamp. Fireman allowed men to pass the station after he had found gas in a heading; he, however, told them to put out their lamps at a certain place and wait there until he came in to them. This they did, and then one of them borrowed a pipe of tobacco, left the group and went into his stall, which branched off near where the men were sitting. About 10 or 15 minutes afterwards the explosion occurred, some of the survivors stating that the flame came from the stall which the man went into. Inspector suspects that the man had struck a match to light his pipe, and perhaps his lamp, which had previously been put out. Breach of General Rule 4 on part of fireman who was killed. (*B*)
23	„	1	Explosion of firedamp, on returning to his working place after the firing of a shot. Naked lamps. Owners subsequently adopted safety lamps. (*A*)
24	„	7	(Bryncoch.) Explosion of firedamp. Safety lamps used. Official report states that the disaster was probably caused by the firing, by an imperfectly protected Davy lamp, of gas which had been liberated by a fall of roof. The workings were for the most part rather damp and, on the floor, even wet in places. There was an entire absence of accumulated dry coal dust. A careful search was made to discover, if possible, whether coal dust had intensified the explosion, but nothing was found which afforded proof that it had done so. The effects of the explosion were almost entirely confined to one place. The firemen were afterwards provided with a safer type of lamp. (*C*)
25	„	1	A small quantity of gas had accumulated in the rise rib of a stall, simply for want of a sheet to direct a current of air into it, and the gas was ignited by one of the naked lights in use. (*A*)

* Reports by Mr. Chester Jones and Mr. Robson. C. 8,059, 1896.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1897.		
26	East Scotland	2	Engaged, on an idle day, under supervision of under-manager, in connecting two places, in one of which there was afterdamp; after endeavouring unsuccessfully to expel the firedamp by "waffing" and running a hutch backward and forward, it was agreed to fire a charge of gunpowder near the gas to "break it up," and while doing this an explosion took place. The act was an extremely rash one, and the under-manager was subsequently convicted and fined £5 for a breach of General Rule 12 (*g*). Inspector states that the explosion was not complicated by coal dust. (*D*)
27	„	1	(Oil shale mine.) Deceased and another man went through a fence into an abandoned road to get rails, when gas was kindled by their naked lights. The place was fenced off and known to contain gas, and the men should not have entered it without the fireman's authority. Inspector states that explosion was not caused or complicated by coal dust. (*A*)
28	„	1	(Oil shale mine.) Deceased, engaged in driving a slope road, went into an adjoining upset for a private purpose and ignited some gas with his naked light. The upset had been inspected about eight hours previously by the fireman, and reported clear of gas. Inspector states that the explosion was not caused or complicated by coal dust. (*A*)
29	West Scotland	1	The fireman fired a shot of carbonite in an accumulation of firedamp, and the sparks from the tape fuse lighted the gas. Safety lamps used at the colliery. The fireman was convicted of an offence against General Rule 12 (*g*), but, as he himself was severely injured by the explosion, he was let off with a small fine. (*D*)
30	„	1	Fireman, making his morning inspection, recklessly, with a naked light, ignited an accumulation of firedamp, and was killed. (*A*)
31	Yorkshire and Lincolnshire.. ..	3	Explosion of gas in a sinking shaft while firing four shots of gelignite by fuse lighted by means of red hot iron bar. No evidence of gas before explosion, but inspector came to conclusion that one of the shots exploded prematurely and ignited gas. Electrical firing afterwards adopted. (*D*)
32	Midland	1	Deceased (a horse-driver) was sent by a header, who was working in the main heading, to bring an air-pipe out of the counter heading, which had been driven some distance to a fault and was standing. In removing the pipe the safety lamp was knocked over and the light extinguished. Deceased, who used a naked light in his usual occupation, struck a match to enable him to find his way out of the heading, when a quantity of gas was ignited. There was serious negligence on the part of the under-manager and deputy in not having ventilated the place or examined it before the commencement of work. They were committed for trial on a charge of manslaughter, but acquitted. (*B*)
33	South Stafford	1	Deceased (contrary to regulations) left his own working place to seek a tool, and in passing through a return air-way with a naked light fired a small accumulation of firedamp and died of his burns. The colliery was worked throughout with naked lights. (*A*)
34	„	1	Deceased, returning to work after a meal, was burned by a small explosion of firedamp. Naked lights. (*A*)
35	South Western	1	Explosion of firedamp at his naked light when entering his place of work in the morning. Owners of mine declined to adopt safety lamps. (*A*)
36	South Wales	5	An explosion of firedamp, which the inspector came to the conclusion was caused by the fireman, who was among the killed, having unlawfully opened his safety lamp; intensified by the large amount of fine coal dust which the workings and roadways contained. (No mention of watering.) (*C, F*) *
37	„	1	Deceased's lamp had either not been locked or had been opened, for it seemed clear that he was carrying an open light along the level, and that he ignited gas in passing a cavity at the end of the arched road, 70 yards away from the shaft. Here his lamp was subsequently found in two portions. (*C*)

* See plan in Mr. Robson's Report. 1898. C. 8,819 I.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1898.		
38	East Scotland	3	Explosion of firedamp. Notwithstanding prohibition of shot-firing owing to presence of gas, two miners prepared and fired a shot (breach of General Rule 12 (*b*). The evidence pointed to the gas having been ignited by the flame of a lucifer match used in lighting the fuse of the shot, rather than to flame accompanying the explosion of the shot. Inspector states the explosion was principally due to firedamp but was assisted to some extent by coal dust, which was observed in a coked state on timber in the section after the explosion. The main roadway leading from the section was dry, but not sufficiently dusty to carry forward the explosion. The discipline of the mine was bad, no less than 24 miners having been convicted and fined after the explosion for taking matches and pipes into the pit. (*D F*)
39	West Scotland	4	(Drumpeller, Coatbridge.) An explosion of coal dust on a dook used as a main haulage road, which was due to the firing of a charge of gunpowder contrary to the Explosives Order. There was no attempt to water the place of firing, and there was evidence of negligence on the part of the management in failing to see that the necessary precautions were taken. The explosion was not a violent one, but extended throughout the dook and for some distance beyond it. There were quantities of fine dust on the haulage road, and the only means of watering was a stream of water from a hose at the top of the dook which was turned on every day, and wetted a portion of the floor. (*D, F*) †
40	.. ..	1	His naked light ignited firedamp in an unventilated part of his working place. It was doubtful whether the fireman had previously examined the place. (*A*)
41	„	7	A sudden outburst of firedamp rendered the air current explosive in a section and the men withdrew. The fireman, who was not aware of what had taken place, entered the section and ignited the firedamp at his naked light. The workings are dry, and after the explosion there was a coating of coal and clay dust throughout most of the working places, with traces of coked dust on some of the props. Apparently the explosion was intensified by the ignition of the coal dust. Safety lamps were introduced. (*A, F*)
42	„	1	Deceased, contrary to regulations, went into a fenced-off disused road to "knock" through to his working place, when his naked light ignited some firedamp. (*A*)
43	„	1	Explosions of firedamp, evidently caused by the son of the deceased unlocking his safety lamp and striking a match to relight it. Workmen at this mine frequently prosecuted for smoking or having matches and lamp keys in their possession. (*B*)
44	Newcastle	1	Explosion of firedamp caused by a gunpowder shot partially blown out. Workings free from dust and roadways wet. No trace of coking after the explosion. No gas had been reported for 12 months, but safety lamps were in use. (*D*)
45	Durham	2	Explosion of gas in a sinking pit, caused by the sparks from a fuse. (*D*)
46	Yorkshire and Lincolnshire.. ..	1	Explosion of gas by a naked light of deceased who went into a place which was fenced off. (*A*)
47	„ „	2	Explosion of gas, which had been liberated by a fall of coal, at the candles of the men who were working at the fall. (*A*)
48	Ireland	3	Explosion of firedamp, candles being used. Re-entry after an absence to take a meal. Want of ventilation. The mine was abandoned directly after the accident. (*A*)
49	South Stafford	1	Deceased entering his working place with a naked light caused an explosion of gas. Another workman with a safety lamp ought to have preceded him according to the regulation. Ventilation not good, but no firedamp discovered after the explosion. (*A*)
	1899.		
50	East Scotland	1	(Oil shale mine.) Deceased had gone near the waste and ignited some gas at his naked light that had accumulated there. (*A*)
51	„	2	Deceased with naked lights were accompanying the fireman, who had a safety lamp, when he was making his inspection before the entry of the miners, and going first, in spite of the fireman's warning, up a rising road ignited firedamp. (*A*)

† Reports by Messrs. Ronaldson and Hall. C. 8,835, 1898.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1899—*continued.*		
52	East Scotland—*continued*	2	Explosion of firedamp. Shot-firing by deceased, who were not authorised to fire shots, on a branch road in a section of the mine which was dry and somewhat dusty. The section was known to contain gas and safety lamps were used, but no inspection by a fireman was made. The manager was absent and there was no proper supervision. The owners were subsequently convicted for not appointing an under-manager and fined £12. Proceedings against the manager for contravention of the Explosives Order broke down on technical grounds. (*D*)
53	„	1	Deceased, a fireman, was making his examination before the entry of the men, and was carrying an open light as well as a safety lamp, although the examination was required to be made with a safety lamp only. Ignited some firedamp. (*A*)
54	„	1	(Oil shale mine.) The fireman discovered gas when making his first examination, but appeared to have carelessly allowed the miners to approach the place with open lights while he was attempting to remove it. An explosion then took place. (*A*)
55	West Scotland	1	On entering his working place to commence work his naked light ignited firedamp, which the fireman affirmed was not present when he made his inspection. (*A*)
56	„	1	Apparently gas had lodged in a cavity caused by a fall, and a further fall seems to have dislodged the gas, which the air current carried to his naked light. (*A*)
57	„	1	Owing to inadequate ventilation gas had accumulated in the pit and deceased was attempting to clear it out. His safety lamp went out, and he sent the miner working with him down the pit to relight it. The latter went seven yards from the shaft, struck a match, in defiance of regulations, and ignited the gas. (*B*)
58	„	2	One of the deceased went for a private purpose into a level in which there had been no work for a week and which was not fenced off, when his naked light ignited an accumulation of firedamp. Fireman had failed in his duty in not fencing off the discontinued working place and not making an inspection that morning of the level face. (*A*)
59	„	1	Safety lamps in use. The deceased worked alone when the explosion took place. A tobacco pipe was afterwards found close to his working place, where a hurdle screen was erected to prevent gas from a feeder from accumulating. Adequacy of ventilation open to question. (*B*)
60	„	1	Safety lamps alone used. The fireman lit the fuse of a shot of compressed gunpowder. No sooner was the fuse lit than it ignited firedamp and the deceased was killed. The shot afterwards went off. Fireman failed to make inspection properly. (*D*)
61	„	1	The deceased was brushing a road head, and had gone along the working face, when his naked light ignited some firedamp. It was said that the deceased was told not to go along the working face. (*A*)
62	„	1	Apparently gas had accumulated in an unventilated place near where he was working and a fall of roof forced it out, when it was ignited by his naked light. (*A*)
63	Newcastle	1	Shot-firing ignited an accumulation of gas. Inspector states: "A close scrutiny was made of all timber, brattice cloth, &c., with a view of ascertaining whether coal dust had been instrumental in causing or developing the explosion, but the indications of coking were very slight, indeed, it could hardly be called coking at all. The general surroundings were all more or less damp, and, in fact, in some places saturated with moisture." The evidence indicated want of proper precautions in firing the shot, though there was no proof of breach of Explosives Order. (*D*)*
64	.. ..	1	Explosion of gas on the main intake airway of the district. Naked lights used. No evidence as to how the gas had accumulated there; though on that day there had been a phenomenal fall in the barometer. The ventilation was good and no gas had been seen for three or four years. (*A*)

* See plan in the Inspector's Report Cd. 134 I., 1900.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1899—*continued.*		
65	Durham	1	Owing to gas being discovered in a working place, a fence was put up across the road with the word "danger" written on it in chalk. The men were told they could not work in that particular place, but it did not appear that the men were informed that gas was there. Deceased, contrary to the Special Rules, went over the fence with a naked light to bring out his gear, when the gas ignited. The inspector considered the mine ought to have been worked with safety lamps, and a prosecution of the manager for a breach of General Rule 8 was successful. (*A*)
66	„	6	A powder shot on being fired by the deputy blew through a parting in the stone and ignited some firedamp in an old place. Locked safety lamps used. Inspector states there was not much dust and practically no fine dust anywhere in the district, but notwithstanding that, some of the timber showed distinct signs of coking. The place where the shot was fired was distinctly damp. A considerable area was affected by flame and heat. (*D*, *F*) *
67	Yorkshire and Lincolnshire.. ..	2	The men were "scouring" in order to put out a goaf fire. A heavy fall of roof took place, the lamps were all extinguished and a small quantity of gas was ignited by the fire. No evidence of negligence. (*E*)
68	Liverpool	2	Two miners using safety lamps were driving a heading which made gas very freely, when a small iron wedge flew back breaking a lamp glass, causing an explosion of firedamp, which injured the two men and set the brattice on fire. An hour later, when the manager and underlooker were trying to put out the burning brattice, a second explosion took place causing their death. A third explosion took place two hours' after the second. The inspector thought the management ought to have kept a closer watch on a working place which was giving off so much firedamp. (*C*) †
69	South Stafford	4	Naked lights. Experience of the seam had taught that in faulty ground firedamp might be expected. On the day of the accident the stall in question was examined by the competent person with a safety lamp, and he reported that no gas could be found. Then the workmen were permitted to begin work using naked lights. The inspector judged from appearances that a heavy fall had occurred at the far side of the stall, which had released some firedamp, forcing it upon the naked lights. (*A*)
70	„	1	Deceased's safety lamp was hanging upon a hook driven into the coal side of the headway. A piece of coal suddenly burst from the face, struck the lamp and broke its glass, and a little firedamp, which may have been released at the same moment, exploded at the exposed flame. (*C*)
71	South Wales	1	Deceased entered a stall not at work during the night shift to get a "pricker," and ignited gas with his naked light. He had been warned by the fireman that there was a little gas in this place which was not, however, fenced off as it should have been in accordance with the Special Rules. Safety lamps afterwards introduced. (*A*)
72	„	19	(Llest, Pontyrhyl.) Accumulation of gas in the face of the coal in a stall fired by naked lights, probably owing to a derangement of the ventilation. H.M. Inspectors were of opinion that in the neighbourhood where the explosion occurred the mine was dry and dusty; other experts called at the inquest stated that they did not consider any part of the mine dry and dusty, but this was more an expression of opinion than a statement of fact. There were indications of coked coal dust on many of the props. This latter indication, combined with the fact of there being charring and burning spreading over a considerable area, and that the accumulation of gas was probably not of very great extent, point to the conclusion that coal dust played a not unimportant part in the explosion. It is probable that the wet condition of some parts of the mine prevented the explosion spreading farther than it did and causing still greater loss of life. Owing to several ignitions of firedamp before the explosion the inspector had urged the adoption of safety lamps, but his advice was disregarded by the management. The Home Office Counsel considered there was an offence against General Rule 8, but came to the conclusion that the evidence was not sufficient to support a prosecution. Safety lamps were introduced when the colliery commenced working again. (*A*, *F*) ‡

* See plan in the Inspector's Report. Cd. 134 III., 1900.
† See plan in Inspector's Report. Cd. 134 VI., 1900.
‡ Reports by Mr. Chester Jones and Mr. Robson. Cd. 17, 1899.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued*.

No.	District.	Number of Deaths.	Remarks.
	1900.		
73	East Scotland	1	Deceased and another fireman began to inspect the workings after a holiday. While they were proceeding up a brake incline gas was ignited by deceased's open light, which he carried on his cap, and caused him to fall down the incline (gradient 75 deg.). Gas was known to be in the rise place some distance away, and both men carried naked lights besides their safety lamps, but never before had gas been seen in a working brake incline. (*A*)
74	„	3	The deceased were engaged in trying to remove an accumulation of gas in a place where the ventilation was feeble. One of the deceased (a fireman) went forward with a Davy safety lamp when a somewhat violent explosion occurred, coming from where the fireman was. The gauze of the lamp was not found. The place was dry and rather dusty. The primary cause was insufficient ventilation, the return airway being of inadequate size, and considerable leakage taking place from the intake. (*C*)
75	„	1	Deceased went to survey a part of the workings with his overman and fireman, all of them carrying open lights, when gas was ignited by the open light. Gas had not been seen in the section, but three years before it had been found in an opposite section. The place should have been inspected daily, but apparently this had not been done. (*A*)
76	„	1	(Oil shale.) Gas had been discovered in deceased's working place and the fireman prevented him starting, but sent him to work in another place. After breakfast the deceased went to have a look at his own working place, against the fireman's order, and his open light caused an explosion. He was well aware of the presence of gas. (*A*)
77	„	1	The firemen had reported to deceased's fellow workmen that he had found a small quantity of gas at the face and had wafted it out and permitted them to pass in-bye, giving them an unlocked Davy lamp with which they might examine the place. On reaching the upset they entered with naked lights and ignited some gas. The fireman acted improperly in allowing the men to pass; he was charged with culpable homicide, but was acquitted. (*A*)
78	„	1	Deceased (a fireman) had made his first inspection with a safety lamp and found all clear, and was proceeding with his second inspection (6 hours afterwards), using a naked light, when some gas, which appears to have collected in the interval, was ignited by his open light. (*A*)
79	West Scotland	1	When making his inspection previous to the night shift, and immediately after the fan had been restarted after a stoppage of 14 hours for repairs, an explosion of firedamp took place. He evidently was using his naked light, which was found lying beside his safety lamp. Inspector states that it is almost incredible that a man should thus court death, but when his naked light was afterwards found lying beside his safety lamp, the only conclusion one can arrive at is that while carrying an open light an explosion followed on his walking into an accumulation of firedamp. (*A*)
80	„	2	Firedamp, apparently suddenly released by the breaking of the roof, ignited at an open light. Owners introduced safety lamps, and the inspector opposed an attempt to withdraw safety lamps six months after. (*A*)
81	„	1	After receiving a safety lamp he illegally lighted an open lamp, and on entering his working place he ignited firedamp, which appears to have accumulated after the fireman's inspection. (*B*)
82	„	6	A section of dip working sealed off by a brick stopping was being re-opened. Two shots of Nobel's blasting gelatine were fired in the stopping, 30 ins. thick, blowing it down and causing an explosion of firedamp accumulated behind it. The men all retired nearer the shaft, and an hour afterwards a second explosion occurred, fatally injuring six men. Inspector was unable to ascertain the cause of the second explosion. It seems evident that a body of firedamp accumulated behind the stopping, on being released by the shots, worked its way upwards until it came in contact with a naked light, and the explosion thus initiated was carried on and intensified by the coal dust, as these workings are both dry and dusty. The first explosion may have set fire to some timbering or brattice cloth which kept burning until the body of firedamp reached it and became

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1900—*continued.* West Scotland—*continued*		ignited.* The explosion brought to light several irregularities and the manager was convicted and fined £15 for breaches of General Rule 8 (*b*), General Rule 10 (*i*), and Special Rule 86 (failure to see that safety lamps were examined on the surface). (*D, F*)
83	„	1	While making his morning inspection, apparently with a naked light as well as with a safety lamp, he ignited firedamp. (*A*)
84	„	1	By an accident to the rhones used for conveying the ventilating current to the face of the mine the air had been cut off for 36 hours, and the deceased recklessly went in to make an inspection with a naked light, and caused an explosion of firedamp. (*A*)
85	„	1	The deceased entered a road adjoining his working place, and on climbing over a fall, his naked light ignited firedamp. The fireman stated that he had been redding the fall a short time before the explosion. The deceased ought not to have gone into the road. (*A*)
86	„	1	Explosion of firedamp, ignited by the tape fuse of a shot of Kynoch gelignite. The charge was illegally inserted in a break caused by a previous shot. The shot-firer and another brusher were injured. (*D*)
87	Newcastle	4	Ignition of gas in a sinking shaft at a naked light. Manager thought the gas had come through the water from another seam. Safety lamps afterwards introduced. (*A*) †
88	„	1	Explosion of gas caused by the firing of a shot, which was evidently much overcharged. The gas was probably liberated by a fall which occurred between the lighting of the fuse and the explosion of the shot.† Working with safety lamps. (*D*)
89	Yorkshire and Lincolnshire.. ..	1	Explosion of small quantity of gas at a naked light. (*A*)
90	Liverpool	8	Deceased were engaged in sinking operations at a depth of 245 yards from the surface, and when they were filling dirt into the hoppit an upheaval of the floor occurred, and an outburst of firedamp gas ignited at the candles. Inspector considered the manager showed a serious want of judgment in permitting the use of candles at this depth, and recommended the substitution of electric light. (*A*) ‡
91	Midland	2	The two deceased and other men were stowing dirt in an old roadway, when the deputy in charge of the district went up the road carrying a lighted candle, and ignited some firedamp, which appears to have come from the old workings. The quantity of gas fired was very small. (*A*)
92	South Stafford	1	Large heap of fallen coal lying on the floor. The place was said to have been examined about an hour and a half previous. No gas was then found, yet at 8 a.m. some fired at the naked light of deceased. Safety lamps ought to have been used at the place. (*A*)
93	„	1	Deceased was drawing timber out of a road. He had drawn three settings when there was a heavy fall of roof. After the place had quieted down, he returned to examine the fall. The roof of the cavity, formed by the fall, broke down again and dislodged some firedamp, which fired at his naked light. Safety lamps ought to be used in the inspector's opinion in drawing timber. (*A*)
94	„	1	Deceased and another man went into their working places contrary to the instructions of the fireman, who had been unable to examine these places. An explosion of firedamp took place at their naked lights. (*A*)
95	South Wales	2	While waiting outside their working place, where a pillar of coal was being worked out, the roof fell, and gas—which apparently was liberated by the fall—was carried by the current upon their naked lights. (*A*)
96	„	1	Deceased went in to attend to a pump, and was not again seen until his body was found by the fireman, who was making his inspection, about 160 yards further in than the pump. No one knew why he had gone beyond his working place. Naked lights. (*A*)
97	„	1	Burned by an explosion of firedamp on entering a stall, not at work, to put his tools away. He was using a naked light. (*A*)

* See plan in the Inspector's Report. Cd. 536 I., 1901.
† See plans in the Inspector's Report. Cd. 536 IX., 1901.
‡ See Inspector's Report. Cd. 536, IV., 1901.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1901.		
98	West Scotland	1	He entered a disused heading which was not fenced off, and had not been inspected by the fireman; his naked light ignited an accumulation of firedamp. After this explosion the owners were induced to work the seam with safety lamps, but failing to come to an agreement with the miners the working of the seam was stopped for some months. (*A*)
99	„	1	Without sanction the fireman allowed the deceased to inspect the workings instead of doing it himself, and while doing so his naked light ignited firedamp. (*A*)
100	„	2	The fireman found gas in two adjoining working places. After, it is said, he cleared out the gas from one place, and permitted the miners to commence work in it with a naked light, and he and other two men were clearing out the gas with safety lamps in the other place, when firedamp ignited at the naked light of one of the deceased, who was in the place from which the fireman said that he had expelled the gas. The fireman was wrong in permitting any of the workmen to enter these places until the firedamp was entirely dispelled from both. The circumstances pointed to inadequate ventilation. (*A*)
101	„	1	While the deceased (a fireman) was "waffing" gas, along with two roadsmen and a miner, from a working place in which he had found an accumulation when making his inspection, an explosion happened. It was said that another roadsman came in with a naked light and ignited the gas, but this was not proved. Disregard of the regulations in regard to adequate ventilation, safety lamps being lighted underground, and naked light in a place where safety lamps were used. The investigation of this accident brought to light serious irregularities. The manager was convicted for failing to provide adequate ventilation, and was heavily fined. The overman was convicted and fined under Special Rule 2 for failing to see that the safety lamps were lighted, &c., at the surface. The third roadsman was charged under Special Rule 87 (5) with having a naked light in a place where safety lamps were used, but this was "not proven." (*A*)
102	„	2	On entering their working place, where stoops were being extracted 2½ hours after it had been inspected by the fireman, their naked lights ignited fire-damp. After the explosion the owner agreed to work the pillars out with safety lamps. (*A*)
103	Durham	1	A staple from one seam to another was full of water, and it was being taken out by means of water cages. When the water was lowered 16 ft. some gas came off and ignited at an open light. The under-manager had given instructions for the use of safety lamps, but failed to see that his instructions were carried out. The management decided to use safety lamps entirely in future. (*A*)
104	„	1	On going into some stables in the Hutton seam with a naked light, some gas exploded at it, and the deceased was fatally burned. Inspector was of opinion that the gas had come from a goaf, owing to the barometric pressure having suddenly been reduced during a gale. No gas had been seen in these stables before, and the ventilation was good. As a precaution it was decided to use safety lamps there in future. (*A*)
105	Yorkshire and Lincolnshire.. ..	1	Small colliery. On the day of the accident the pit was standing, and the deceased (the under-manager) and another man went down to get coal. Just as they reached the face the other man's safety light went out. The under-manager, with gross recklessness, took off the top of his lamp to relight the dark one. Immediately there was a sharp explosion of gas, and he was killed. The ventilation was found defective. Colliery afterwards abandoned. (*C*)
106	North and East Lancashire ..	4	Explosion of firedamp, probably lit at a candle, while the men were endeavouring to remove a large accumulation by "batting," i.e., disturbing it by waving their waistcoats and pieces of brattice cloth. Inspector states that the floor and sides of the level of the shunt—where other men were stopped by the fireman—were very wet, and to this may be ascribed the escape of the men in the shunt. Enquiry showing that the ventilation was hopelessly inadequate, and the agent was convicted and fined heavily for a breach of General Rule 1. Safety lamps were afterwards introduced. (*A*) *

* See plans in Inspector's Report. Cd. 1062, X., 1902.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1901 —*continued.*		
107	Liverpool	4	The men were engaged in getting machinery out from one of the seams, just after it had been abandoned. The fireman appears to have fired a charge of Roburite on a haulage wheel, in order to break it up for purposes of removal, in a level near the main haulage brow, in a dusty part of the mine. The shot was not placed in a drilled hole or stemmed in any way, as required by the Explosives Order, and it appears to have been fired without the knowledge or consent of the superior officials. An explosion of coal dust occurred, which travelled through the main roads. The inspector, in his evidence as the inquest, stated that he examined for gas and found no signs, and apparently everything pointed towards the conclusion that the shot had ignited the dust, and that dust alone was responsible for the whole damage. (*D*, *F*) *
108	Stafford	2	Small colliery. Explosion of firedamp, caused by a naked light, in an upcast shaft, where the deceased men were fixing stays for guide ropes. The men had been warned to use safety lamps, and, as there was evidence of inadequate supervision, the inspector required the appointment of a certificated manager under Section 20 (3) (*c*) of the Act. (*A*)
109	„	4	(Talk-o'-th'-Hill.) Firedamp was probably ignited by a gob fire, and the explosion was carried through the 7 ft. and 8 ft seams by firedamp and coal dust, both seams being dry and dusty. The explosion was an extensive one, traversing roadways exceeding 8,000 yards in length, but it failed to traverse a portion of the 7 ft. seam where the roads were free from coal dust. The extension of the explosion from one seam to the other, and along the main intake airways to the down-cast shaft, was probably due to coal dust alone. The explosion did not traverse any of the main return airways, these roads being practically free from coal dust. Being Whit Monday, the fan was stopped to effect repairs, and only four men were underground, otherwise the results would have been more disastrous. (*E*. *F*) †
110	„	2	Explosion of firedamp. The deceased, after working a "blow-george," or hand-fan, near their working place, which they had been informed was "dampy," went into the face. From a statement subsequently made by one of the deceased, it appeared that before he reached the face his safety lamp was extinguished by blackdamp, and he struck a match to re-light it, when a violent explosion took place. The inspector states that the locality was naturally wet, and the explosion was not extended by coal dust. (*B*) ‡
111	Cardiff	4	Fatally burned by an explosion of firedamp in an old level which was being reopened. They were clearing a large fall of roof, 700 yards in-bye of the mouth. The gas ignited at the naked light of one of the men while he was examining the place. No inspection was made before the men entered, in accordance with General Rule 4. No manager had been appointed, and the owner and agent were convicted and heavily fined for the offence. (*A*)
112	„	81	(Universal.) An extensive dust explosion by which all the persons in the pit at the time, except one, lost their lives. The explosion took place at the end of the night shift when a large number of men had just left the pit. It passed through all the main roads, with the exception of a few portions naturally damp, and penetrated into the stall roads and working faces in each district, but avoided the principal return airways. There was evidence of the mine being dry and dusty throughout, except in a few places where there was natural moisture. The cause of the explosion was obscure, but Professor Galloway came to the conclusion that it originated from the firing of a shot in a roadway close to the face without any attempt being made to water the locality. (*D*, *F*) ¶
113	„	1	Deceased and others were clearing gas out of a double road stall. It was said they were using safety lamps, and two of the injured men said that while carrying a small hand fan up the stall they saw the gas ignite at the deceased's safety lamp. The lamp was found to be in good condition, and did not appear to have been overheated. (*C*)

* See plan in Inspector's Report. Cd. 1062, XI., 1902.

† See Report by Mr. W. N. Atkinson. Cd. 856, 1901.

‡ See plan in Inspector's Report. Cd. 1062, IX., 1902.

¶ Report by Professor Galloway. 1901.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1901—*continued.*		
114	Cardiff—*continued*	1	While waiting near a brattice sheet placed in a small opening in the roof, deceased was burned by an ignition of firedamp, presumably brought down from the crevice by the passing of a horse and haulier under the sheet. Naked lights used. (*A*)
115	„	8	(Llanbradach.) Explosion of coal dust caused by shot-firing on main intake. The explosive used was carbo-gelatine fired electrically. There was no evidence of the presence of firedamp. The place where the explosion occurred was dry and dusty, and the inspector considered that the method of watering it was inadequate. The explosion extended over a wide area, but only 14 men were in the seam at the time of the explosion; shot-firing was carried on between shifts, as firedamp was freely given off. (*D*, *F*) *
116	Swansea	1	Explosion of gas on a main road at a naked light after a fall of roof. The mine was worked with safety lamps, and, although no gas was found by the officials at the fall, the inspector considered that a naked light ought not to have been exposed. (*A*)
117	„	1	Explosion of gas in a heading, ignited by firing a charge of Bulldog powder; fired by fuse. Inspector states that if this mine had been a dry and dusty one, the explosion would have had very serious results, but fortunately there was no dry dust along the drift referred to, and the flame died away, but not before burning 7 men who were congregated near the outer end of the drift. (*D*)
118	Southern	2	Explosion of firedamp at a naked light. The men were engaged in walling a staple pit from one seam to another. Gas accumulated under the scaffolding owing to no proper provision having been made for ventilation, and ignited at the naked lights which they were using. Fortunately the explosion was not extended by dust to other parts of the pit. The inspector had previously urged the adoption of safety lamps without success. (*A*) †
	1902.		
119	East Scotland	4	Two men were engaged cutting through a hitch, when a sudden outburst of gas took place and an explosion resulted. Two other men, who were at breakfast near the pump, were overcome with the foul air and perished. Gas evidently fired at an open light. Coal dust played no part in the explosion. Safety lamps were being introduced gradually into the colliery, and after the explosion the process was accelerated. (*A*)‡
120	„	1	Two men were engaged redding a fall on a level road when some débris fell from the broken roof in the hole above carrying with it some gas which had been liberated. The gas ignited at an open light and caused the explosion. Coal dust played no part in the explosion. (*A*)
121	„	1	A fall of roof had taken place at a fault on a level road revealing a cavity, which had been formed some time previously when proving the fault. While the broken was being examined, a second fall took place, bringing down some gas which fired at a naked light. Coal dust played no part in the explosion. (*A*)
122	„	3	The fireman failed to turn out to his work in the morning, and the overman undertook the duty of inspecting the working places. He discovered gas in the working place of the deceased miners. After finishing his inspection he returned and took the two miners with him to clear the place. When the gas was cleared from the face, he expected the mixture had been carried in-bye with the air current, and lighting his open lamp an explosion resulted, whereby all three men were fatally burned. The overman committed a breach of Special Rule 38 in allowing the miners to enter the working place until a report had been made that it was safe. Coal dust played no part in the explosion. (*A*)
123	West Scotland	2	Gas, which was known to be given off, accumulated at the brushing face, and was ignited by a naked light. Apparently one of the deceased had taken down a screen, and this prevented the air current from playing upon the feeder. Safety lamps ought to have been used, and they were introduced after the explosion. (*A*)
124	„	1	Gas accumulated in a hole caused by a fall, which had not been properly inspected by the fireman. It was ignited by the naked light of deceased's son, who was also injured. (*A*)

* See Report by Mr. Martin. Cd. 855, 1901.

† Reports by Mr. S. T. Evans, K.C., M.P., and Mr. Martin. Cd. 665, 1901

‡ See Inspector's Report. Cd. 1,590, V., 1903.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1902—*continued.*		
125	West Scotland—*continued*	1	Deceased appears to have gone into a disused place for a private purpose, when his naked light ignited firedamp. (*A*)
126	Newcastle	1	Safety lamps used. A tub of coals had been left in a place which had been fenced off on account of gas having been found. Deceased appears to have removed the fence and gone into the place with his pony to get the tub, when the explosion occurred. Deceased's lamp was found in the tub in good order. Matches and a candle were found in his clothes. The probable cause of the explosion was that the lad's lamp had gone out and he had become frightened and struck a match. Coal dust, so far as can be gathered, did not play any part in the explosion. (*B*)
127	„	3	Two of the deceased went, with naked lights, into a place which was fenced off, when an explosion of firedamp occurred. It was stated that this fence was erected not on account of gas but because the place was so far before the air that the hewer complained of its being warm. The place had not been examined before the men went to work. The jury animadverted on this point and recommended the discontinuance of "Scotch" lamps which are frequently carried in the cap, and therefore, more likely to ignite gas in the roof. (*A*)
128	Durham	1	A tub got off the way at a turn, and the deceased went to assist the putter to get it on again, and when doing so his lighted candle ignited a small quantity of gas which had collected in a gullet in the roof. The gas was evidently liberated owing to a sudden fall in the barometer. Safety lamps were subsequently introduced. (*A*)
129	Yorkshire and Lincolnshire.. ..	1	The place had been examined, *so it was stated* (but this is improbable) about 15 minutes before, and no gas was found. The deceased had a safety lamp, but as soon as he reached the face of the heading he struck a match to light a candle, and immediately there was an ignition of firedamp. Naked lights should not have been used because there had been a previous ignition of gas in the mine. The discipline was found to be lax, and the manager was dismissed. (*B*)
130	„ „	1	A dam of old railway sleepers was being built at the entrance of a heading, and firedamp gathered in it unknown. When the dam was being finished there was an explosion. Naked lights were being used, and it is evident that the gas issued from an old bolt hole in one of the sleepers, and fired at one of the workmen's candles and then fired the accumulation behind the dam. Safety lamps should have been used. (*A*)
131	Liverpool and North Wales ..	2	Explosion of firedamp when blasting with a permitted explosive (amvis) to make height. The place was examined by one of the deceased, and no gas was found, and the shot was fired by an electric battery in the usual way, and, notwithstanding the examination, some gas was ignited. The shots at the colliery were fired by special men between shifts, and on the present occasion every precaution seems to have been observed. (*D*) *
132	„ „ ..	9	Explosion of firedamp in a sinking shaft, which probably was ignited by a short circuit of the electric light cable; electric light being used to light the shaft. The ventilation was inadequate, and proceedings were taken against the manager for breaches of General Rules 1 and 7, with the result that substantial fines were imposed. (*E*) *
133	„ „ ..	1	Shot-firing with special Bulldog powder. The fireman stated at the inquest that he made an examination previous to the shot being fired, and found no gas. The shot was fired by means of an electric power fuse, and an explosion occurrred, gas having evidently accumulated. (*D*)
134	„ „ ..	2	Explosion of firedamp when the underlooker was attempting to remove an accumulation from the face of one of the working places. This was a breach of Special Rule 16, and the owners subsequently proceeded against the underlooker, who was fined. It was doubtful whether the explosion was caused by a safety lamp or by a spark from a steel shovel striking the hard stone. The ventilation in the pit was insufficient. (*E*)
135	Stafford	1	Deceased was burned while making the examination before the commencement of work. He carried a safety lamp, but the explosion was probably caused by a naked light, either a match or a candle. (*A*)

* See plan in Inspector's Report. Cd. 1,590, IX., 1903.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1902—*continued.*		
136	Stafford	1	Gas ignited by a naked light of an illegally opened safety lamp. Safety lamps with a more secure lock were afterwards introduced. (*C*)
137	Cardiff	8	(Fochriw.) An explosion of firedamp near the face during the night (repairing) shift, confined to one district where 13 persons were employed. There were 105 persons altogether in the seam. A fall in the main drift on the previous night caused an accumulation of gas by interfering with the ventilation of the workings in question, and the explosion was brought about by the firedamp being carried by the air current to the face and ignited at an unlocked safety lamp. The explosion was arrested by the naturally wet condition of the main drift in one direction and by a wet staple in the return airway in the other direction, otherwise it is certain the explosion would have been much more widespread. Dust played no part in the explosion. The inspector thinks this explosion clearly demonstrated the value of wet roads, though no watering was done artificially. Naked lamps were used in the day shift as there was little evidence of firedamp, but safety lamps were used in the night shift as a precaution in the event of gas being liberated by repairing on roadways. Screw-locked lamps, however, enabled the men to open their lamps as on the occasion of this explosion. After the fall referred to the men ought to have been withdrawn, and the two firemen of the district, who escaped, were prosecuted and fined for a breach of General Rule 7. Safety lamps were introduced throughout after the explosion. (*C, F*) *
138	„	1	Explosion of gas which had accumulated in a hole on the double parting. The parting had been full of water but was drained to a depth of 3 ft. the previous night. The fireman said he had examined the hole that morning and found no gas. Deceased's partner went in soon after to see how much roof had fallen and ignited gas with his naked light. (*A*)
139	Swansea	1	Explosion of firedamp by a naked light near the face of a level which had been connected with some old workings. The place had been carefully examined on the morning of the explosion and no gas found. The level was very wet. (*A*)
140	„	1	Explosion of gas by a naked light at a "parting" on a road where there had been a fall. It was stated that the cavity was clear when examined about three hours previous to the explosion, but there was a suspicion that the examination was not made at all or only partially. (*A*)
141	Southern	16	An explosion mainly of fire damp which originated at the face and was of small force and extent. There were no signs of it having been much increased by coal dust. The cause was uncertain but was probably due either to a broken safety lamp (one such lamp was found) or to an explosion of gas in a lamp. The ventilation of the mine was not satisfactory, and the inspector had drawn the attention of the management to traces of fire damp in the current for some time before the explosion. The ventilation of the working place where the explosion is supposed to have started was rendered defective by a heavy fall. Artificial watering was carried out efficiently on the main level by a system of water pipes and hose, and to this was attributed the failure of the explosion to spread to the other workings. The authors of the offical report consider this explosion an important illustration of the value of artificial watering. (*C, F*) †
	1903.		
142	East Scotland	1	Explosion of gas caused by a naked light. The men heard the roof "working," and fearing a fall, were preparing to leave when the explosion occurred. A subsequent examination showed that the roof had taken the "first break" and a considerable quantity of gas had been liberated. Safety lamps had previously been used, but these had been withdrawn, and the jury added a rider that the management had acted imprudently in doing so. (*A*)
143	„	1	During the shift the deceased left his working place and proceeded to the road above to get some tools, and gas was ignited at his naked light. The fireman had made an inspection of the place in which deceased worked, but admitted he did not go to the place where the gas was ignited. (*A*)

* See Mr. Gray's Annual Report for 1903. Cd. 1590, IV.

† Reports by Mr. S. T. Evans, K.C., M.P., and Mr. J. S. Martin. Cd. 1398, 1903.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1903—*continued.*		
144	East Scotland—*continued*	1	It was proposed to restart a certain heading part and extend it for a haulage way to a section at work to the rise, and it is probable that deceased was examining the roadway to see what repairs were necessary, when his naked light ignited some gas, causing an explosion. Some brattice had got damaged and the air had short circuited and gas accumulated. The roadway had not been examined as it should have been. (*A*)
145	„	2	The deceased shortly before the close of their shift left their working places and on their way out-bye went into an abandoned place for a private purpose, and at a point immediately outside of the fence they ignited firedamp with their naked lights. The fireman in making his inspections did not go beyond the fence but regularly tested for gas there. Gas had never previously been found in the section. (*A*)
146	West Scotland	2	Upon entering their working place to commence work after it was reported " all clear " by the fireman, their naked lights ignited firedamp. Safety lamps were introduced after the explosion. (*A*)
147	„	1	An outburst of water had filled up some dip workings from which the water was being pumped. The lowering of the water restored the ventilation and brought out gas which evidently ignited at the naked light of deceased, although he had been instructed to use a safety lamp. (*A*)
148	Newcastle	1	Explosion of firedamp, primarily due to the unexpected accumulation of firedamp in a disused exploring place, the entrance to which was fenced off, but was contributed to by deceased passing the fence with a naked light without authority. (*A*)
149	Stafford	1	Explosion of firedamp by naked light. Gas brought down by a fall while repairing intake air-road. (*A*)
150	Cardiff	1	Burned by an explosion of gas which was ignited by a safety lamp; the glass had been broken by a fall which brought the gas down from a hole in the roof. The dip where the explosion occurred was rather damp and there was practically an absence of coal dust. The glass of the lamp was unevenly moulded, and barely one-eighth of an inch thick in one place. The attention of the makers was drawn to this defect. (*C*)
151	„	1	Deceased and another lad went into an abandoned stall with their naked lights. There was a small fault in the roof, and it was thought that a little gas was given off from it. The place when examined three hours before the accident was found to be clear. It was thought the deceased, who had worked in the stall before its abandonment, took the other lad up to show him the good section of coal there. (*A*)
152	Swansea	2	The explosion was caused by gas in a cavity, formed by a fall of roof, being ignited at one of the naked lights used by two repairers engaged in clearing the fall. The inspectors pressed for the introduction of safety lamps, but the owners decided to stop working that part on the ground of expense. (*A*)
	1904.		
153	East Scotland	1	Explosion of gas at a naked light when making his inspection after a holiday, during which the fan had been stopped. The stopping of the fan was contrary to the provision of General Rule 1, and the manager was convicted and fined for a breach of the Rule. (*A*)
154	„	1	Explosion of gas at a naked light in a road recently abandoned. A fall took place at one of the old faces, and the fireman, without consulting his officials, took off the screens, cutting the air off the abandoned portion. Deceased apparently went into the road for a private purpose. (*A*)
155	West Scotland	1	When arching a stone mine, his naked light ignited firedamp in a large cavity in the roof. Fireman alleged he had examined the cavity and found it free from firedamp. (*A*)
156	„	2	Deceased worked alone, and were engaged in taking out a stoop. They worked with safety lamps. The deceased were found lying at the side of a full hutch. The cause of the explosion could not be ascertained. The safety lamps were found locked, but a key was found in a coat pocket. (*E*)
157	„	1	The seam was worked with safety lamps, but as two tobacco pipes, a box of matches, and a burnt match were afterwards found at the point where the explosion occurred, it is evident that the

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1904—*continued.* West Scotland—*continued*—.		gas was ignited while the deceased and his neighbour were smoking, although the latter denied all knowledge of the pipes and matches. He admitted that they were aware of an accumulation of gas in the place. (*B*)
158	,, ...	1	The deceased brusher and his neighbour were entering a working place to commence work, two hours after it had been inspected by the fireman and reported to be clear, when their naked lights ignited firedamp. A strong feeder of gas was afterwards found issuing from a break in the roof. (*A*)
159	,, ...	1	He stated that when making his morning inspection his safety lamp went out, and that on striking a match to relight it, firedamp ignited. He appears to have also been carrying a naked light contrary to the regulations. (*B*)
160	,, ...	1	The deceased, without authority, left the section of workings in which he was employed to get a pick in another ventilating district not examined by the fireman, from which the ventilation had been cut off, and his naked light ignited firedamp. The explosion happened on a Sunday, and the air compressor which ventilated the place had been stopped, contrary to General Rule 1. (*A*)
161	Newcastle	2	Explosion caused by the flame from a shot fired with a permitted explosive (stowite). After the shot was fired it was found that gas coming out of the solid coal was burning. Before the fire could be put out an explosion occurred, injuring several of those engaged. Later on in the day a party of about 25 persons went underground to make an inspection, when another explosion occurred, which killed two persons. The shot-firer said he found gas before firing the shot, but that he dispersed it. No coked coal dust was found. (*D*) *
162	,, ...	1	Explosion at the face of the brushing of the main gateway of a district, and was caused by the two parts of a safety lamp becoming detached while the lamp was in an inflammable mixture. The lamp was locked by a lead plug, but it could be screwed up and down a few turns for adjusting the flame. The deceased was unscrewing the lamp to lower the flame when the bottom fell away and explosion occurred. The locking arrangements were strengthened after the accident. (*C*) *
163	,, ...	1	Explosion of gas by shot-firing (compressed gunpowder). Deceased stated after the accident that he found the place clear when he examined it some little time previous, but at the time of the explosion, and after given a lighted touch paper, ignited by a red-hot wire from his safety lamp, to the hewers to light their shots, he found gas, but too late to avert an explosion. The places were damp and free from dust. It was doubtful whether the examination for gas was thorough. Permitted explosives fired by battery were introduced after the accident. (*D*)
164	Yorkshire and Lincolnshire ..	1	A shot charged with bobbinite and fired with a high-tension battery in the ripping of a heading in a seam close to the shaft ignited some gas. Place was very wet. (*D*)
165	,, ,, ...	1	A shot charged with bobbinite ignited a small quantity of gas. Shot fired with high-tension battery. Place examined before firing and found clear. There was little coal dust in the place, and the explosion did not spread. (*D*)
166	Midland	2	Deceased men were repairing a roadway and were using locked safety lamps. They had only been at work a short time when they heard the roof moving, and then a few small pieces of stone fell from the roof, and immediately afterwards an explosion occurred. The place previously examined and found clear. A lamp with a broken smoked glass was afterwards found. Inspector thinks that when the men heard the roof move, one of them raised a lamp to see what it was, perhaps tilted it on one side, so that the glass would become smoked, and eventually crack, probably some of the falling roof completing the destruction of the lamp-glass, and so exposed a naked light, from which the gas ignited. (*C*)
167	Stafford	1	Ignition of firedamp, ignited by candle. Another man had a safety lamp to make an examination, but the deceased went in first with his naked candle. Safety lamps were introduced for a time, but they were withdrawn, and another explosion occurred three months afterwards. (See No. 169.) (*A*)

* See plan in Inspector's Report. Cd. 2,506, II., 1905.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1904—*continued.*		
168	Stafford—*continued*	3	Explosion of firedamp and coal dust ignited by a broken safety lamp. While the men were working a loud "goth" or concussion of the strata was heard. A safety lamp had probably been hanging on a post and had been shaken off by the "goth." The lamp was found with the glass broken, and had evidently been the cause of the explosion. There were slight indications of burning on the timber for 8 or 10 yards of the face, and some coke dust on a sleeper. The inspector thinks this accident was a simple ignition and rapid burning of firedamp and coal dust, within a limited area, rather than an explosion properly so called, and the workings being dry and dusty, if greater force had been developed, the explosion would have been an extensive one. (*C*)
169	,, ...	1	Explosion of firedamp, caused by a naked light, when the men were at work in a "fast side," the extremity of which was 8 yards beyond the air current. It was stated that the place had previously been examined with a safety lamp and no gas found. Safety lamps were re-introduced. (See No. 167.) (*A*)
	1905.		
170	East Scotland	1	Explosion of gas, caused by the naked light of a man going into a disused road. There was no fence to prevent anyone going into the road. Coal dust played no part in the explosion. The manager and fireman were prosecuted for breach of rules, and fined. (*A*)
171	West Scotland	1	Deceased had been sent to clear away a fall of roof on a road. While at work a fresh fall brought down gas from a cavity and it was ignited by his naked light. (*A*)
172	Newcastle	2	Explosion of gas. The working places of the deceased had not been examined prior to their going down, but the chargeman told them they had "no call to go to the face until he came." Deceased men, however, did not wait for the chargeman, but were going to the canch at the face of the main road to work when the explosion happened. The gas evidently fired at a naked light of one of the deceased. The workings in the district where the explosion happened were damp to dry. No coked coal dust was observed and it is doubtful if coal dust had played any part in the explosion. The barometer was very low. (*A*) *
173	,, ...	1	Blown out shot. Deceased died 10 days after. When the inspector visited the place on the day after the death of the deceased he found it dry but not markedly dusty, and the roads leading to it were wet. No trace of fire or coked coal dust was observed. The inspector thinks the hole had not been stemmed with clay but with small coal and coal dust, and that this stemming had extended the flame of the gunpowder; he does not think gas was present; he thinks the explosion was not due to an explosion of gas or to the explosion of the gunpowder alone, but rather to coal dust being ignited by the flame of the gunpowder. (*D F*) *
174	Yorkshire and Lincolnshire.. ..	1	Dirt was being packed in a "benk" when a fall of stone took place and liberated a small quantity of gas, which ignited at the deceased's naked light. Deceased (a deputy) was supplied with a safety lamp for the purpose of making an inspection but had left it at the entrance of the level. He also failed to make an inspection under General Rule 4 before work was commenced. Safety lamps were introduced after the accident. (*A*)
175	,, ,, ..	1	Deceased and other men were engaged in putting in wire rope guides into a shaft when an open flaming paraffin lamp was knocked off a girder and on to a scaffold below. The oil was spilt and burned, and immediately an explosion occurred. Some gas had burst through 15 yards of water which had accumulated at the bottom of the shaft. Inspector condemned the use of lamps of this kind, and secured the substitution of electric lamps and safety lamps. (*A*)
176	Midland	3	Explosion of firedamp. Deceased and another man were standing under a break in the roof, three of them had safety lamps and the other held a lighted candle. The latter fired the gas which had come from a cavity in the roof. Safety lamps were afterwards introduced. (*A*) †
177	Stafford	1	Explosion of firedamp, ignited by a shot of compressed gunpowder blowing through into goaf. Most of the roads in the locality were wet or damp, and the effects of the explosion were confined to 90 or 100 yards from the point of origin. In one direction there was a limited amount of dry coal dust, and this appeared to have contributed to the explosion, as coked dust was observed on the timber in that locality. (*D, F*)

* See plan in Inspector's Report. Cd. 2,910, II., 1906.

† See plan in Inspector's Report. Cd. 2,910, VII., 1906.

Digitized by Google

PARTICULARS OF FATAL EXPLOSIONS—*continued.*

No.	District.	Number of Deaths.	Remarks.
	1905—*continued.*		
178	Stafford—*continued*	1	Deceased left his working place and went to another part of the workings in search of a drill, taking with him a naked light. An accumulation of firedamp had occurred in the place to which he went, and this ignited at his candle. The place where the explosion happened had not been examined as it ought to have been. The under-manager was prosecuted and fined. (*A*)
179	Cardiff	33	(Cambrian, Clydach Vale.) The cause of this explosion was doubtful, but the inspector came to the conclusion that it started by the ignition of a considerable quantity of gas at the safety lamp of a bratticeman who was attempting to deal with an accumulation of gas. The safety lamp used was the Clanny type, with a single gauze, and the inspector believed that the gas exploded with violence inside the lamp and blew out the gauze. The explosion traversed each district, and the comparatively small loss of life was due to the fact that it was a repairing shift—the day shift having left the mine an hour previously. The return airways were damaged to an unusual extent, which led the inspector to believe that the air was charged heavily with firedamp. The important feature of the explosion was that the roadways were well watered by an effective system of pipes and hose; beyond the extent of the pipes watering casks were used, and the journeys were sprayed at each parting. The evidence given was to the effect that all the main roads were watered the day before the explosion, but the watering, though efficient so far as it went, does not appear to have touched the fine dust on the timbers, and the conclusion was that there was sufficient fine dust there to carry the explosion. (*C*, *F*) *
180	„	119	The explosion, which took place during the day shift, was caused by the firing of a heavy charge of gelignite (not a permitted explosive) in blowing out a small barrier of coal. A pit had been sunk from the 9 ft. to the lower 5 ft. seam, and a heading was being driven to the upcast shaft. The ventilation was probably inadequate at the place and the flame from the explosive ignited some firedamp. The explosion travelled up the pit, which was dry, and throughout the 9 ft. workings; but failed to reach the upper seams, apparently owing to the wetness of the shafts. Some watering was done in this seam by means of tanks with a plug, but this was an ineffective method which only wetted the centre of the road and left the roof and sides dry. In the upper seams there was an extensive system of water pipes. There was evidence unfortunately of serious laxity in regard to the shot-firing Rules, and examination for gas, and there was a breach of General Rule 13, but as the manager who had the entire control of the colliery lost his life no prosecution was instituted. (*D*, *F*) †
181	„	2	Explosion of firedamp while sinking operations were in progress. A heavy discharge of gas from the bottom of the shaft took place. Naked lights were prohibited, but it was stated at the inquest that a naked light was burning at the time of the explosion, and the inspector thinks this was the cause of the explosion. (*A*)
182	Swansea	11	An explosion of gas and coal dust which originated on a level near the face. The method of working rendered ventilation difficult and the ventilation of the place where the explosion took place was made defective by the throttling of an airpipe. Safety lamps were in use (bonneted Clanny, with screw locks), but they were all found intact after the explosion. As a tobacco pipe and some matches and two contrivances for opening lamps were found in the pockets or clothes belonging to the deceased, it seemed to the inspector that the most probable explanation of the ignition of the gas was that one of them exposed a naked light. The explosion was confined to a small area by the wetness of the roads, and the inspectors considered that but for this it would have extended throughout the workings. The owners and manager of the colliery were prosecuted for a breach of General Rule 1, but the case was dismissed. (*B*, *F*) ‡
183	„	1	Engineman burned by the ignition of gas at the top of a shaft which was being unwatered prior to being reopened. At the time of the explosion a depth of 217 yards had been reached. On the evening of the day, while the engineman and other men were lighting and hanging up two oil lamps at the top of the shaft, some drops of flaming oil fell down the shaft, ignited gas which had accumulated therein, and caused an explosion. No means had been taken to ensure adequate ventilation of the shaft; the shaft had been tested some little time before for gas, but none was discovered. (*E*)

* See Report by Mr. Gray. Cd. 2,680, 1905.
† Reports by Mr. Milner-Jones and Mr. J. T. Robson. Cd. 2,772, 1905.
‡ See Annual Report by Mr. J. T. Robson. Cd. 2910, X.

Digitized by Google

Digitized by Google

INDICES.

I. GENERAL INDEX 325

II. THE EVIDENCE OF EACH WITNESS INDEXED SEPARATELY 340

Digitized by Google

Digitized by Google

INDEX I. (General Index).

NOTE.—*When a series of questions refer to the same subject, the number of the opening question only is given.*

Abercarn Colliery Explosion, arrest of, by slightly damp area, 10173 (*pars.* 28 and 33), 10208.

Abertysswg Explosion, *see* McLaren Explosion.

Accidents :
- Coroner's inquests, officials making reports to Home Office, suggestion as to qualifications of, 14459A (*par.* 33).
- Face of mine, comparative freedom from accidents, *see title* Dust, *sub-heading* Face.
- Falls of roof and sides, number of accidents and death-rate from, comparison with number of explosions, &c., 10428, 10546 (*pars.* 28 and 55), 10585, 11165, 11358, 11613, 11796, 11810, 12136A (*par.* 6), 12218, 12590, 14182A (*par.* 6), 14432, 14894A (*par.* 4), 14936, 15448A (*par.* 6), 15538, 15583, 15685, 15937A (*par.* 8), 19545, 19561.
  - Coal Mines Regulation Act, breach of, views of inspector as to, 15957.
  - Dry seams, falls in, 19568.
  - Ferndale Collieries, No. 1 Pit, fall in, 19545, 19561.
  - Statistics comparing number of falls in wet and dry mines, absence of, 11360, 11365, 12223, 12976, 12983.
  - Summer, number of falls in, 15562, 15570.
  - Timbering system in relation to, 14333, 16187.
  - Watering, effect of, on, *see title* Watering, *sub-heading* Dangers and difficulties of—Effect on roof, sides and floor.
- Haulage accidents, *see that title.*
- Report of, regulations as to, 17679, 17683.

(*See also title* Explosions.)

After-Damp, *see title* Explosions.

Albion Colliery Explosion :
- Arrest by watered floor, 12230.
- Death-rate, probable effect on, if explosion had occurred during day shift, 10952.

Altofts Colliery :
- Explosion at :
  - Account, general, of, 15617A, 15620 *et seq.*
  - Amount of dust, 15634, 15645, 15669.
  - Arrest of :
    - By engine house wall, 15637, 15643, 15657.
    - By road damp from water carried to stables, 10173 (*pars.* 29 and 33), 15637, 15645, 15656, 15660, 15906.
    - Points of, 15635, 15646.
  - Cause of—shot-firing in dusty atmosphere, 15617A, 15622, 15644, 15652, 15831.
    - Explosive used—gunpowder, 15652.
    - Gas, absence of, 14406, 15635.
  - Course taken by, and damage done by, 10173 (*pars.* 10 *et seq.*), 10469, 15651, 15652A, 15658, 15668, 15905.
  - Plates illustrating, 15617A, 15622, 15624, 15627 *et seq.*, 15634, 15649, 15651 *et seq.*, 15657.
  - Precautions taken subsequently to, 15670, 15674, 15822, 15899.
  - Pressure, 15904, 15910.
    - Symptoms of men, indications of pressure afforded by, 15913.
  - Report and paper on, by Professor Galloway, 10173 (*pars.* 8 and 9), 10187.
  - Wagons, dust from, 10173 (*par.* 11), 10186, 10341, 10471.
- Method of working (straight line of face), freedom from accidents resulting, 15617A, 15621, 15682, 15684, 15773, 15851, 15922.
  - Adoption of, in other collieries, question as to, 15690.
  - Coal cutters, use of, 15692, 15851, 15923.
  - Description of method, 15776, 15923.
  - Plates illustrating, 15617A, 15682, 15692.
  - Timbering system in connection with, 15777, 15781.

Altofts Colliery—*cont.*
- Pillar left at sinking of pit in 1863, size of, 15634.
- Rescue gallery at, 15792, 18914A (*par.* 7) :
  - Plan of, 15792.
  - Tests at, and account of work done by men wearing Draeger apparatus and Weg apparatus, 18914A (*par.* 8), 18924, 19061.

Ambulance, *see title* Rescue Work and Appliances.

American Mines (United States), freedom from water and from dust, 14190.

Ankylostomiasis :
- Alpine Tunnel, outbreak among workmen constructing, 11272.
- Case suspected, 12753.
- Temperature and depth of mines in relation to, 14894A (*par.* 4), 14960.
- Watering, danger of, in relation to, 10546 (*par.* 31), 11000 (*par.* 16), 11270, 14894A, (*par.* 4), 14959 18784.
  - Oil or tar as substitute for water, suggestions as to, 14459A (*par.* 13), 14495, 14560.
- Westphalian mines, outbreak in, 11270.

Arching, *see title* Zones, *sub-heading* Arching.

Babbington Colliery :
- Doors separating one set of workings from another, 11191.
  - Plates illustrating, 11194.
- Zones, dry and dustless, *see title* Zones, *sub-heading* Dry and Dustless—Babbington Colliery.

Barriers or Boundaries of coal, 12621, 12891, 12897, 13632. (*See also title* Pillars of Coal.)

Belgian Mines :
- Character of, 14192.
- Conchoidal fracture of coal, 13288A (*par.* 2).
- Deep mines in, 12068.
  - Dust in, 12614.
  - Watering in, effect of, on health of men, 10546 (*par.* 30), 12300.
- Dust in, 10180, 12614.
- Experimental gallery at Frameries, 10546 (*par.* 73), 10968.
- Watering, physical conditions favourable to, 13567, 13570.

Blackwell Colliery, Explosion at :
- After-damp :
  - Arrest of, 12085.
  - Death from, 11982, 12121.
- Arched dustless zone, arrest of explosion by, 11837A (*par.* 8), 11848, 11902, 12084, 12111, 13734.
  - Dampness of zone, insufficient to influence arrest of explosion, 12111.
  - Length of zone, 11905, 12084.
  - Plates illustrating position and effect of dustless arching, 11902, 12133.
  - Position of zone, plan showing, 11902, 12133.
  - Purpose for which zone was arched—not specially to arrest explosion, 12089.
- Cages not injured, 11944.
- Cause of explosion :
  - Dust in old packs and crevices, 11953, 12020.
  - Manner in which shot was fired, 12129.
- Course traversed by explosion, 11902, 11981, 12121, 15937A (*par.* 10).
- Dust :
  - Cause of explosion, 11953, 12020, 12129.
  - Character of dust, 11848.
  - Experiments previously to explosion, inability to procure an explosion from, 12038, 12087.
- Gas, absence of, 12040.
- Plates illustrating, 11902, 12133.
- Stokes, Mr., report on and evidence as to, 11919, 11940, 11944.

Blaendare Explosion, cause of, 14115.

Blantyre (Dixon's Collieries), Explosion at, 13621, 17780.
- Cause of, 16878.
- Safety lamps, type used, 17791.

Digitized by Google

Blown-Out Shots, *see title* Shot-firing.
Brancepeth Explosion :
Cause of, 10549, 10723, 14197, 14459A (*par.* 19), 14604, 14613, 14663.
Report on, to Home Office, unsatisfactory character of, 14459A (*par.* 33).
Breathing Apparatus, *see title* Rescue Work and Appliances.
Cadeby Colliery, dust from screening-plant, exhaustion by system of fans and pipes, 10532, 14211, 14450, 18444.
Camerton Explosion, cause of—shot-firing, 15937A (*par.* 2), 16047, 16086.
Chesterfield Mining Institute :
Experiments with dust, 12926, 13076, 13669.
Definition of an explosion, 16055.
Districts from which dust was taken, 13844.
Report, extract from, 13674.
Paper read before, on "How a Mine may be Dry and not Dusty," 11001.
Claycross Colliery Explosion, cause of, 13227.
Clifton Hall Colliery Explosion, 18725.
Clydach Vale Colliery Explosion :
Cause of, 13307, 13310, 13613.
Dust above timbers, 13616.
Timbers not blown out, 13613.
Watered zone failing to arrest, 10526, 13302, 13347, 13353, 13378.
Coal-Cutting Machinery :
Dust from, character of and quantity of, 10546 (*par.* 21), 10578, 10757, 10765, 10780, 10896, 15694, 19095A (*par.* 7), 19176, 19396, 19456.
Electric, 15392, 15399, 19608.
Ferndale Colliery, experimental use of, at, 19390.
Method of bringing down coal after it is cut, 19461.
Shot-firing, effect on, 11963, 12106, 19595.
South Wales, use of, in, 19176, 19187, 19461, 19595.
Straight faces, working with, 15692, 15694, 15851, 15923.
Plates illustrating, 15692.
Coal Mines Regulation Act, 1887 :
Adequacy of, or necessity for amendment of, views as to, 12919A (*par.* 18), 13025, 13211, 13218, 13223, 13256, 14459A (*par.* 30), 14510, 14515, 14552, 14562A, 14753, 14871, 14878, 15891, 15896, 15902, 17061, 17294A (*par.* 9), 17548 (*par.* 21), 17979A (*pars.* 2 and 7), 18057, 18121, 18124.
(*See also title* Shot-firing, *sub-heading* Acts, Orders, Regulations, &c., *and title* Safety Lamps, *sub-heading* Act of Parliament).
Manager's certificate of competency, section as to, 16461, 17772.
Safety lamps, regulations as to, 14629, 14632, 14647, 14751, 14753, 14876, 15234, 15381, 18470, 18474.
Shot-firing, regulations as to, *see title* Shot-firing, *sub-heading* Acts, Orders, Regulations.
Coal Mines Regulation Act, 1896, Clause 5, Sub-section 3, 14518.
Coal Tax, utilisation of money from, to defray cost of experimental galleries, suggestion as to, 10962.
"Comet," experiment with, 12136A (*par.* 2), 12150, 12416.
Definition of a "Comet," 12417.
Commission, Royal, on Coal Dust, 1891–1894 :
Altofts explosion, evidence as to, 15644.
Difficulty found in dealing with the subject, 13253.
Elemore explosion, evidence as to, 14129.
Experiments with coal dust, evidence as to, 10718, 16368A (*par.* 2), 16431, 18255A (*par.* 1), 18263, 18520.
Flame igniting coal dust when mixed with fire-damp, evidence as to, 10549.
Inflammability of various kinds of dust, comments on, 16368A (*par.* 2).
Miss-fire shots, importance attached to, 15937A (*par.* 2).
Temperature of air on its course through the pit, diagram showing, 18901.
Water cartridges, evidence as to, 16342.
Committee on Bobbinite, evidence before, as to large charges, 16658.
Cornish Mines, watering in :
Health of miners, effect on, 11273, 11821.
Timber, effect on, 11288, 14151.
Courrières Colliery :
Explosion :
Arrest of explosion, cause of, 10546 (*par.* 16), 10560, 10568, 10801, 16234.
Plan showing, 10560.
Breathing apparatus, death of man wearing, 19018, 19091.
Cause of, 15937A (*par.* 4).
Vortex rings, possibly the cause, 10264, 10272, 10287.
Course traversed, 10546 (*par.* 16).
Courrières Colliery—*cont.*
Explosion—*cont.*
Doors for shutting off afterdamp, suggestion that lives might have been saved by, 17294A (*par.* 14).
Dryness or dampness, character of mines as to, 11793.
Dust tests, 10546 (*pars.* 16 and 73), 10556, 10717, 10721, 10798, 10801, 10803, 11386, 11418, 11532, 15989, 16204, 16234, 16426, *and Appendix* 1. *page* 295.
Plan showing some of the principal workings affected, 10546 (*par.* 16), 10560.
Possibility of similar accident in England, views on this point, 10815, 10948, 10954, 12682.
Character of coal makes comparison impossible, 15937A (*par.* 3).
Powder used for blasting, 10868.
Underground communication, extent of, and effect of, 10815, 10818, 10820, 10954, 11195.
Timbering system, effect of, on number of accidents, 15925.
Denaby Explosion, 15301.
Denny Explosion, 17548 (*par.* 4), 17553.
Arrest of, 17566, 17569.
Cause of, 17548 (*par.* 4), 17556, 17800, 17804.
Course traversed, 17801.
Deaths, number of, 17680.
Discipline :
Elementary schools, instruction in, as to value of discipline, suggestion as to, 14849, 14887.
Leaders of Miners' Associations, advice to men as to, 14891.
Lancashire mines, strict observance in, 11468, 11571, 11768.
Lectures to men on, question as to, 14857, 16672.
Doors in Mines, *see title* Explosions, *sub-heading* Doors.
Drumpeller Colliery Explosion :
Arrest of, by damp at pit bottom, 18224.
Cause of : shot-firing, 14113, 17981, 18092, 18160, 18204.
Course of explosion, 18218.
Dusty character of mine, as to, 18216, 18220.
Greasy nature of dust, 17998.
Force of, 18218.
Safety lamps not used, 18215.
Durham : Witnesses giving evidence as to—Mr. Armstrong, Mr. Blackett, Mr. Carnes and Mr. Parrington. (*For separate indexes to their evidence, see Index II*).
Dust in Mines :
Boiler explosion, possible effect on dust, 11219.
Classification of mines as dusty or non-dusty, views as to, 10798, 11837A (*par.* 1), 11842, 12136 (*par.* 1), 12145, 12653A (*par.* 1), 13288A (*par.* 1), 13367, 13662A (*par.* 1), 13669, 14182A (*par.* 1), 14195, 14459A (*par.* 23), 15445, 15448A (*par.* 1), 15457, 15937A, 15990, 16176.
Coal-cutting machinery, dust produced by, 10546 (*par.* 21), 10578, 10757, 10765, 10780, 10896, 15694, 19095A (*par.* 7), 19176, 19396, 19456.
Danger from ;
Appreciation of, by miners, extent of, 16582, 16694, 16737, 16832, 17370, 17548 (*par.* 7), 17551, 18498.
Instruction of men as to danger, 16392, 16695, 16832, 16861.
Deep mines chiefly affected, 10173 (*par.* 1), 10174, 10372, 12614, 12919A (*pars.* 2 and 3), 12928, 13095, 13288A (*par.* 1), 13095, 13367, 13460, 16321.
(*See also sub-heading* Inflammability of various kinds of coal dust.)
Definition of a dusty mine, 15067, 16326, 16808, 17429, 17979A (*pars.* 2 and 7), 18057, 19095A (*par.* 1), 19100.
Engine planes, inflammability of dust on, 17377, 19095A (*par.* 8), 19109.
Experiments, *see that title.*
Explosions, dust :
Cause of, views as to, 10295, 10319, 10325, 10389, 10546 (*pars.* 1 *et seq*), 10547, 11837A (*par.* 2), 11855, 12020, 12039, 12136A (*par.* 2), 12148, 12170, 12305, 12311, 12413, 12490, 12492, 12653A (*par.* 2), 12694, 13076, 13091, 13250, 13261, 13288A (*par.* 2), 13333, 13383, 13662A (*pars.* 3 and 13), 13669, 13763, 13849, 13892, 14005, 14182A (*pars.* 2 and 3), 14197, 14203, 14239, 14459A (*pars.* 2 and 19), 14465, 14486, 14587, 14600, 14798, 15171 (*pars.* 13 and 15), 15261, 15286, 15296, 15403, 15412, 15448A

Digitized by Google

Dust in Mines—*cont.*
Explosions, dust—*cont.*
Cause of, views as to—*cont.*
(*par.* 2), 15896, 15898, 15937A (*par.* 13), 15962, 16055, 16086, 16607, 17402, 17517, 17521, 17548 (*par.* 3), 17733, 17787, 18255A (*par.* 1), 18265, 18380, 18384, 18522, 18710, 18722, 18726, 19095A (*par.* 4), 19121.
Amount of dust required to cause an explosion, views as to, 11511, 11576, 11756, 11859, 12136A (*par.* 2), 13041, 13352, 14035, 15261, 15461, 15649, 16028, 16178, 16205, 16604, 16621, 16814, 17195, 17587, 17613, 18299A, 19101.
Small amount possibly more dangerous than large, views on this point, 16596, 16606, 16622, 16703, 16708, 16740, 16874, 16933, 17588, 17827, 18382, 19102.
Character of dust, importance of, rather than of quantity, 11844, 11848.
Chesterfield experiments, decision arrived at, 13076, 16055.
Crevice of old brick, dust lodged in, 11953, 12020, 12811.
(*See also sub-heading* Inflammability of various kinds of coal dust.)
North of England Institute of Mining and Mechanical Engineers, paper read before, 14459A (*par.* 2), 14465.
Number of, and death-rate from, 10319, 10325, 10745, 15937A (*par.* 1), 17548 (*pars.* 4, 7 and 9).
Particulars of fatal explosions of firedamp or coal dust during years 1896 to 1905, *see* Appendix III., *page* 302 *et seq.*
Pioneering phenomena, theory of, 14459A (*par.* 2 *et seq.*), 14465, 17489.
Pressure exercised by, experiments as to, advocated, 15904.
Face, amount and character of dust in, small danger of explosions, &c., 10173 (*par.* 2), 10179, 10308, 10463, 10546 (*pars.* 22, 25 *and* 38), 10582, 10749, 10755, 10777, 11000 (*par.* 2), 11651, 12136A (*par.* 3), 12174, 12322, 12406, 12408, 12489, 12608, 12653A (*par.* 3), 12695, 12952, 13662A (*par.* 5), 13866, 14037, 14088, 14205, 14208, 14306, 15467, 16440, 17548 (*par.* 18), 17844, 19095A (*par.* 7), 19132.
Brushing away of dust from main haulage roads, probable effect on amount of dust near face, 12919A (*par.* 8), 12940, 12950, 13103.
Distinction between fiery and non-fiery mines in this respect, 14089.
Pillar and stall workings, danger of, as regards face, as compared with longwall system, 14091.
Removal of dust from the face, impossibility of, 10546 (*par.* 23 *et seq.*), 10580.
Fireman's report, inclusion of dust in, views as to, 18568.
Haulage, system of, in relation to dust production, 10546 (*par.* 39 *et seq.*), 10591, 10726, 10903, 14182A (*par.* 6), 14210, 15171A (*par.* 15), 15249, 15677, 15695, 16112A (*par.* 2), 16130.
(*See also title* Wagons, *sub-heading* Dust from.)
Inflammability of various kinds of coal dust, positions in which most inflammable dust is found, &c., 10546 (*par.* 10 *et seq*), 10556, 10797, 11000 (*par.* 4), 11008, 11386, 11394, 11418, 11641, 11837A (*pars.* 3 and 4), 11842, 11844, 11846, 12038, 12136A (*pars.* 2 and 3), 12148, 12401, 12420, 12487, 12498, 12599, 12608, 12639, 12653A (*par.* 2), 12662, 12678, 12679, 12695, 12714, 12728, 12756, 12850, 12858, 12919A (*par.* 4), 12938, 12999, 13288A (*pars.* 2 and 3), 13370, 13382, 13463, 13646, 13662A (*pars.* 1, 2 and 4), 13669, 13678, 13705, 14182A (*pars.* 2 and 6), 14199, 14203, 14246, 14459 (*pars.* 15, 16 and 17), 14500, 14707, 14916, 15117, 15448A (*pars.* 2 and 3), 15989, 16083, 16143, 16202, 16287, 16368A (*par.* 2), 16394, 16396, 16399, 16421, 16431, 16442, 16745, 17432, 17514, 17823, 18389, 18495, 18580 (*par.* 7), 18654, 18663, 18703, 19095A (*pars.* 2, 6, 7 and 8), 19108, 19131, 19168.
Conchoidal fracture, coal having, dust from, more explosive than from coal with cubical fracture, 13464.
Depth at which dust becomes dangerous, 13095, 13288A (*par.* 1), 13460.

Dust in Mines—*cont.*
Inflammability of various kinds, &c.—*cont.*
Experiments as to, *see title* Experiments.
Non-explosive inflammable dust, 13673, 13682, 13690.
Method of work in relation to production of coal dust, 10546 (*par.* 20), 10577, 14091, 15617A, 15682, 15684, 15690, 15851, 15923, 16017, 17840.
Prevention or removal of, or rendering dust non-explosive:
Act of Parliament dealing with, non-existent except as regards shot-firing, 18395.
Arching *see title* Zones, *sub-heading* Arching.
Brushing away (not necessarily in zones), 10459, 10546 (*pars.* 52 and 53), 10611, 11000 (*pars.* 6, 7, 8 and 10), 11025, 11038, 11048, 11050, 11068, 11376, 11381, 11511, 11578, 11725, 12136A (*par.* 5), 12212, 12437, 12478, 12507, 12569, 12712, 12784, 12919A (*pars.* 6, 7 and 8), 12953, 13421, 14459A (*par.* 25), 15134, 15146, 15171A (*par.* 8), 15200, 15259, 15353, 15448A (*par.* 7), 15604, 15610, 15937A (*pars.* 9 and 12), 16079, 16104, 16333, 16335, 17294A (*pars.* 5, 6 and 7), 17332, 17341, 17425, 17435, 17548 (*par.* 20), 18255A (*pars.* 10 and 12), 18318, 18398, 18401, 19095A (*par.* 13), 19231, 19401, 19486, 19488, 19538, 19539.
Extent to which dust can be cleared away by this method, 10462, 10546 (*par.* 49), 10838, 10851, 10854, 11511, 11578, 11711, 11726, 11735, 12243, 12475, 12847, 14182 (*par.* 5), 14235, 15171 (*par.* 8), 17613, 17696, 18255A (*par.* 12), 18400, 18407, 19095A (*par.* 12), 19225.
Frequency with which necessary, 11035, 11667, 11727, 11736, 11741, 12437, 15605.
Zones, dry, dustless, *see title* Zones.
Calcium chloride, or chloride of sodium, mixing with dust, 10173 (*par.* 39), 10235, 10982, 10984.
Compulsion as to prevention or removal, views as to whether desirable, 11728, 11801, 15361, 15608, 16336, 16395, 16398, 16743, 17156, 17163, 17266, 17438, 17888, 18318, 18351, 18395, 18446, 18715.
Compressed air, jets of, 10546 (*par.* 65), 10683, 10852, 11025, 11039, 11184, 15029, 17616.
Discretion to managers as to method, views as to, 11178, 11674, 13255, 17156, 17439, 17901, 18255A (*pars.* 2 and 10), 18349A.
Lycopodium and chalk, experiments with, 10416.
Mixing of non-inflammable matter with coal dust, rendering it non-explosive, 10173 (*par.* 36), 10231, 10238, 10241, 10358, 10416, 10501, 10798, 10808, 11389, 12148, 12199, 12419, 12428, 12653A (*par.* 7), 12752, 12764, 13043, 13288A (*par.* 7), 13475, 13510, 13554, 13645, 13676, 14182A (*par.* 7), 14202, 14262, 16112A (*par.* 16), 16202, 16234, 17548 (*par.* 13), 17566, 17569, 17819, 17840, 18383, 18654, 18704, 19112, 19115.
Oil or tar, use of, suggestions as to, 14459A (*par.* 13), 14495, 14560.
Paving *see title* Zones, *sub-heading* Paving.
Salt or brine, use of, views as to whether desirable, 10173 (*pars.* 38, 39 and 42), 10232, 10365, 10546 (*par.* 66), 10679, 10980, 11837A (*par.* 10), 12653A (*par.* 7), 12751, 13044, 13046, 13288A (*par.* 7), 13510, 14182A (*par.* 7), 14260, 14894A (*par.* 6), 14964, 14967, 15171 (*par.* 8), 15187, 15196, 15258, 15448A (*par.* 7), 15961, 16112A (*par.* 15), 16151, 16883 (*pars.* 2 and 6), 16946.
Depth of mines in which salt would be effective, 16947.
Electric haulage engines, use of salt in neighbourhood of, 16950.
Screening-plant, dust from, 10173 (*par.* 4), 10379, 10532, 10546 (*par.* 45), 10595, 10879, 11000 (*par.* 4), 11013, 11837A (*par.* 3), 12041, 12136A (*par.* 4), 13288A (*par.* 3), 13416, 13662A (*par.* 6), 14182A (*par.* 4), 14308, 14459A (*par.* 18), 14999, 15355, 15358, 15448A (*par.* 4), 15465, 15824, 15937A (*par.* 5), 16074, 16076, 16442, 17383, 17424, 17548 (*par.* 23), 18512, 18580A (*par.* 4), 18660, 19095A (*par.* 7), 19157.
Brick erection for carrying pulleys and doors up to heapstead level, 17380.

Digitized by Google

Dust in Mines—*cont.*
Prevention or removal of, by other methods than watering—*cont.*
Screening-plant, dust from—*cont.*
Dumb drift communicating with downcast shaft, 14453, 16144, 16289.
Experiments in methods of prevention by Lancashire and Cheshire Coal Association, 16328.
Explosion of dust at surface, 15411, 18710, 18726.
Fans and pipes for collection and exhaustion of dust, 10532, 10546 (*par.* 46), 10595, 12046, 14211, 14450, 14894A (*par.* 1), 14916, 14923, 15171A (*par.* 9), 15208, 15355, 15404, 15410, 15448A (*par.* 5), 16112A (*par.* 4), 16137, 16142, 16791, 16883 (*par.* 1), 16910, 16918, 18442, 18580A (*par.* 4), 18596.
Inflammability of this dust, 14916, 15027, 15208, 15463, 16143, 16287.
Partition between screens and downcast shaft, views as to, 14459A (*par.* 28), 14548, 14928, 15448A (*par.* 5), 15600, 15678, 16137.
Raising sides and boxing in shaft, views as to, 12047, 14310, 14928, 16296, 16883 (*par.* 1), 16916.
Removal of screens to greater distance from downcast shaft: present distance of screens from shaft, &c., 11013, 11014, 11111, 11255, 11331A (*par.* 11), 11744, 11837A (*par.* 5), 11948, 12045, 12136A (*par.* 4), 12191, 12431, 12653A (*par.* 7*d*), 12708, 14182A (*par.* 5), 14213, 14312, 14450, 14894A (*par.* 1), 14925, 15171A (*par.* 15), 15448A (*par.* 5), 15680, 15937A (*par.* 6), 16112A (*par.* 3), 16138, 16140, 16328, 16883 (*par.* 1), 18580A (*par.* 4), 18595, 18661, 19095A (*par.* 7), 19157.
Shaking screens and belts, increase of dust since introduction of, 14216.
Sprays in downcast shaft, or watering at surface, 10534, 10596, 10879, 11015, 14533, 14826, 14929, 15247, 19095A (*par.* 7), 19160, 19196, 19450.
Steam jets in downcast shaft, 10173 (*par.* 44), 10302, 10533, 12919A (*pars.* 10 and 11), 12979, 13288A (*par.* 5), 13477, 14533.
Travelling belt, 11013.
Types of screen and method of handling in relation to, 15946.
Vacuum cleaner, use of, 11000 (*par.* 12), 11090, 11181, 11837A (*par.* 8), 11949, 12136A (*par* 5), 12210, 12214, 14894A (*par.* 5), 14949, 15881, 16811, 18322, 18453.
Cost of, 11184.
Frequency of use, 11185.
Wagons, dust-tight, *see title* Wagons, *sub-heading* Type of.
Watering, *see that title.*
Westrumite, use of, views as to, 14495.
Whitewashing, 10546 (*par.* 53), 10611, 11000 (*par.* 11), 15448A (*par.* 7).
Zones, system of, *see title* Zones.
Roadways, amount and character of dust in, importance of keeping main haulage roads free from dust, &c., 10173 (*par.* 3), 10307, 10314, 10322, 10546, (*par.* 35 *et seq.* and 50 *et seq.*), 10584, 10594, 10599, 11000 (*par.* 6), 11331A (*pars.* 10 and 11), 11375, 12136A (*par.* 3), 12147, 12173, 12199, 12646, 12662A (*par.* 4), 12695, 12702, 12756, 13100, 13288A (*par.* 3), 13473, 13475, 13703, 13869, 14088, 14110, 14121, 14141, 14182A (*par.* 3), 14199, 14203, 16441, 17844, 18497, 19095A (*par.* 8), 19112, 19115.
Samples and analyses of dust, 11095, 12661, 12850, 15989, 18654, 18663, 19095A (*par.* 16), 19268, 19305, 19579.
(*See also titles* Courrières Explosion *and* Talk-o'-th'-Hill Explosion).
Scotland, *see that title.*
Sources of dust enumerated, 10173 (*par.* 4), 10546 (*par.* 19 *et seq.* and 34 *et seq.*), 10910, 11000 (*pars.* 2, 3 and 4), 11227, 11731, 12036, 12136A (*par.* 4), 12653A (*par.* 3), 12793, 13288A (*par.* 3), 14182A (*par.* 4), 14306, 14459A (*par.* 18), 15448A (*par.* 4), 15464, 15693, 15695, 18323, 18375.
(*See also sub-headings* Face *and* Roadways, *and title* Wagons.)
Standard of dryness or wetness, suggestion as to, 11331A (*par.* 7), 11432, 11808.
Dust in Mines—*cont.*
Temperature in relation to, 11716, 11720.
Timbering system adopted in some Lancashire mines, rendering complete freedom from dust attainable, 16184.
Ventilation, effect of, on danger of explosion, 17402, 19400.
Wagons, dust from, *see title* Wagons.
Watering, *see that title.*
Weight of various dusts, 15020, 15115, 15123.
Zones, dustless, *see title* Zones.
Dykehead Colliery, explosion at, 18211.
Electricity:
Cables, 15171A (*par.* 12), 15386, 15399.
Coal-cutting machinery, 15392, 15399, 19608.
Fuses, 12815, 16404, 16446, 16491, 17883, 18580 (*par.* 8), 19342, 19387.
Motors, 15171A (*par.* 12), 15386.
Rules, 15385, 19387.
Safety lamps, *see that title, sub-heading* Electric lamps.
Elsmore Explosion; 14024:
Arrest not effected by arched zone, 13732, 13737A, 14128, 14129.
Cause of, 14029.
Dust, inflammable nature of, proved by, 17432.
Face, penetration to, 14095.
Engine Planes:
Dust in, 17377, 19095A (*par.* 8), 19109.
Smooth running, importance of, 19152.
Experiments:
Dust, experiments as to:
Advisability of, suggestions as to experiments, &c., 10554, 11209, 12136A (*par.* 7), 12305, 12404, 12653A (*par.* 1), 12659, 12767, 13094, 13973, 14182A (*par.* 8), 14274, 14503, 15171A (*par.* 13), 15242, 15295, 15649, 15696, 15836, 15876, 15898, 15902, 15931, 15945, 16178, 16259, 16337, 16611, 16814, 16816, 16882, 17195, 17587, 17613, 17899, 18145, 18411, 18456, 18522, 18702.
Inflammability of various coal dusts, experiments as to advocated, 10798, 11331A (*pars.* 7 and 8), 11386, 11422, 11426, 11560, 11641, 11648, 12053, 12136A (*par.* 2), 12305, 12404, 12659, 13662A (*pars.* 12, 13 and 16), 13762, 16112A (*par.* 17), 16180, 17433, 17821, 17911, 17979A (*par.* 2), 17998, 18006, 18389, 18456, 18654, 18657, 18702.
(*See also sub-heading* Instances of Experiments.)
List of desirable experiments, 15696.
Mechanically and chemically mixed dust, experiments with, advocated, 17822.
Official tests, suggestion as to, and as to stations or galleries for, 10546 (*par.* 73), 10717, 10959, 11833, 14275, 16368A (*par.* 3), 17548 (*pars.* 12, 15 and 16), 17979A (*par.* 3).
Central laboratory for each coal-field, under control of mines inspectors, advocated, 15448A (*par.* 8), 15551.
Wagons, watering coal in, experiments as to, 18593.
Zones, dustless, experiments as to, advocated, 11430, 11457, 12949, 13182, 13380, 13738, 13861, 13880, 13903, 14136, 14948, 14950, 14989, 14993, 14996, 15252, 15275, 15433, 15696, 15904, 15937A (*pars.* 10 and 11), 16259, 16587, 16820, 17197, 17548 (*par.* 22), 17732, 18456.
Instances of experiments and conclusions drawn from, 13387, 14712, 15006, 15017, 16259, 18255A (*pars.* 1, 8 and 10), 18262, 18265, 18520, 18654.
Bedson, Dr., experiments by, 14501, 14503, 14713.
Bramall, Mr., experiments by, 15026, 18593, 18654.
Chesterfield experiments, 12926, 13076, 13669, 13844.
Courrières dust, experiments with, 10546 (*pars.* 16, 18 and 73).
Dixon, Professor, experiments by, and experiments suggested by, 14918, 15006, 15115.
Haldane, Dr., analysis and experiments by, 18255A (*par.* 8), 18389.
Hall, Mr., experiments by, 10546 (*par.* 7), 10719, 11644, 15937A (*par.* 2), 15989, 16032, 16368A (*par.* 2), 16396, 16421, 16431, 17548 (*pars.* 11 and 13), 17556, 17567, 18704.

Digitized by Google

Experiments—*cont.*
Dust, experiments as to—*cont.*
Instances of experiments, &c.—*cont.*
Hall, Mr., experiments by—*cont.*
Report by Mr. Hall to Royal Commission on Coal Dust, 16368A (*par.* 2), 16431.
Pickering, Mr., experiments by, 15171 (*par.* 4).
Rhodes, Mr., experiment by, 15336, 18255A (*pars.* 1, 8 and 10), 18262, 18265.
Lancashire, experimental pit in, 11835.
List of desirable experiments, 15696.
Rescue apparatus, experiments with, 15792, 15798, 15803, 18914A (*pars.* 8, 9 and 10), 18924.
Safety lamps, experiments with, 15767, 18255A (*pars.* 1 and 9), 18262.
Shot-firing and explosives, experiments:
Advisability of, 12670, 15833, 15943, 16010, 16637, 17622, 17810, 18411.
Instances of experiments, 14079, 17520, 18255A (*par.* 8), 18288, 18516, 18519.

Explosions:
After-damp:
Deaths from, 11982, 11998, 12121, 17126, 17294A (*par.* 15).
Doors for shutting off, suggestions as to, *see sub-heading* Doors.
Zones, dustless, would probably not arrest after-damp, 10648, 11259, 11680, 12002, 13023, 13992, 15937A (*par.* 10).
Area of, 18346, 18368.
Causes of, 11331A (*pars.* 7 and 8), 11426, 11759, 12100, 13226, 14112, 14630, 14645, 14666, 15171 (*par.* 12), 15304, 15366, 15421, 19095A (*par.* 3), 19120, 19555.
Instance of explosion when no men were in pit, 11759, 19555.
Unavoidable causes, instances of explosions from, 15301, 15317, 15321.
(*See also title* Dust, *sub-heading* Explosions, Cause of.)
Course of, circumstances determining, 14459A (*pars.* 4 *et seq.*), 14469.
Doors for shutting off after-damp, and for arrest of explosions, views as to, 10173 (*par.* 35), 10216, 11191, 11194, 11899, 11901, 14459A (*par.* 6), 14469, 14478, 14485, 14591, 15931, 17294A (*par.* 14), 17353, 17466, 17545, 17559.
Buddle, Mr., doors invented by, 10173 (*par.* 35).
Severance, complete, of one set of workings from another, doors for, 11191.
Plates illustrating, 11194.
Dust Explosions, *see title* Dust, *sub-heading* Explosions,
Experience, personal, of witnesses, as to, number of explosions in mines under their control, &c., 11058, 11076, 13153, 13300, 13452, 14024, 14350, 14384, 14940, 15108, 15126, 15171A (*par.* 9), 15314, 15584, 15997, 16175, 16394, 16460, 16495, 16702, 17054, 17099, 17139, 17294 (*par.* 3), 17339, 17348, 17354, 17355, 17377, 18652, 18725A.
Number of, and death-rate from, 10428, 11331A (*par.* 3), 11371, 11466, 11468, 11601, 11603, 11758, 11768, 12099, 12136A (*par.* 6), 12590, 13662A (*par.* 13), 14630, 14645, 14666, 17548 (*par.* 7), 17573.
Particulars of fatal explosions of fire damp or coal dust during years 1896 to 1905, *see* Appendix III., *page* 302 *et seq.*
(*See also title* Accidents, *sub-heading* Falls of Roof and Sides, Number of, as compared with Explosions.)
Report of feeder, regulations as to, 17746.
Safety in event of:
Place of greatest safety, 11997, 12004, 12018, 12489, 13198, 13203, 13601, 14459A (*pars.* 11 and 14), 14498, 15108.
(*See also title* Dust, *sub-heading* Explosion—Face.)
Instruction of miners as to, and precautions taken to procure safety, 13197, 13202, 14499, 17136.
Scotland *see that title.*
Telephones as a means of communication in event of explosion, 12007.
Ventilation in relation to, 12129, 14459A (*par.* 12), 14469, 14485, 17402, 17522, 19095A (*par.* 5).
Report of feeder, regulation as to, 17746.
Reversing air current, views as to, 17522, 17527.
(*See also title* Dust, *sub-heading* Explosions, *and titles of* Explosions—as Blackwell Explosion, Altofts Explosion, &c.)

Explosives:
Ammonite, 14068, 14459A (*par.* 25), 16232, 16352.
Amount of Charge, 10546 (*par.* 71), 10704, 16653, 16654, 16728, 16775.
Bellite, 11096, 14068.
Bobbinite, 11569, 12816.
Carbonite, 13662A, 13765, 13772, 14068.
Classification advocated, and use only of the highest class in main haulage roads, 13662A (*par.* 14), 13775, 13801, 14068.
Conditions as to use or withdrawal of, 14703, 14706, 15670.
Detonators:
Conditions as to use of, suggestions as to, 17884.
Imperfect, 16447, 18289.
Testing, 18292, 19344, 19414.
Experiments as to, suggestions as to, *see title* Experiments, *sub-heading* Shot-firing and Explosives.
Exclusion of any explosive undesirable, 16826.
Flames given off by permitted explosives, 10867.
Forest of Dean, explosives used in, 16394, 16408, 16413, 16417, 16438.
Gunpowder, 13893, 14065, 14071, 14113.
Purchase by miners from owners only, practice as to, and suggestions as to, 16651, 16660, 16667, 16728, 18626, 19383.
Safety of permitted explosives, views on this point, 10546 (*par.* 71), 10547, 13468, 13662A (*pars.* 13, 14 and 15), 17294A (*pars.* 1, 2 and 3), 17847 18296.
Term "safety" explosives, objections to, "permitted" explosives preferable, 16583, 16727, 18412, 18468.
Saxonite, 16232, 16352.
Testing of permitted explosives, greater stringency and Government test advocated, 10546 (*par.* 71), 10866, 10870.
Training of old officials in use of new explosives, difficulty of, 15982.
Watering, compulsory, probably would result in increased use of, 15937A (*par.* 9).
(*See also title* Shot-firing).

Explosives Order:
Amendment of, views as to whether desirable, 10689, 10701, 10702, 13662A (*par.* 13), 14297, 14513, 14516, 14882, 14894A (*par.* 7), 15937A (*par.* 13), 15996, 16110, 17548 (*par.* 21), 17858, 17884, 17979A (*pars.* 2 and 7), 17991, 18050, 18057.
Caution as to use of permitted explosives, contained in Order of 20th December, 1897, 16002.
Shot-firing, regulations as to, 10546 (*par.* 71), 10689, 10701, 11571, 11639, 14703, 14706, 17761, 17847, 17852, 17880, 18683, 19347.

Fiery Mines: definition and classification, 14297, 14732, 15937A (*par.* 1).

Fire in Mine at bottom of downcast shaft, use of fan to reverse air current, 17530.

Firemen—*See title* Inspection of Mines by Mines Officials.

France, Mines in:
Character of, as to dryness and dustiness, 15174.
Electric lamps in mines, arrangement with Electric Light Company as to provision and maintenance of, 15750.
Screening-plant, fans for collection of dust from, Mines de Dourges, 15171A (*par.* 9), 15404.
Watering, physical conditions favourable to, 13567.

Forest of Dean: Witness giving evidence as to—Mr. Brain. (*For separate index to his evidence, see Index II.*)

Germany, Mines in:
Dust, character of Westphalian mines as to, 15175.
Rescue work and appliances, 15798, 15799, 15817.
Attitude of Government towards, 18914A (*par.* 16), 18985.
"Draeger" apparatus, adoption at Gelsenkirchen, 18937.
"Giersburg" apparatus, 18914 (*par.* 3).
"Shamrock" apparatus, 18914A (*par.* 3), 18919, 19070
Watering system, 10173 (*pars.* 22 and 23), 10198, 10200, 10542.
Adoption in England, views as to whether desirable, 10542, 13363, 13365, 13662A (*par.* 17), 13787, 14182A (*par.* 8), 15540, 15549, 15598, 15937A (*par.* 4), 16093, 16112A (*par.* 7), 16160, 16883 (*par.* 2), 16942, 17169, 17437, 17892, 18714.
Cost of, 10173 (*par.* 23), 10476, 10486, 10624, 10629, 11776, 11777, 12262, 13152, 13932.
Damage caused by watering on introduction of system, 11812.

Digitized by Google

Germany, Mines in—*cont.*
Watering system—*cont.*
Exemptions, 10506, 11170, 11777, 12136A (*par.* 6), 12220, 13343, 14302, 15171A (*par.* 16), 15256, 15328, 15440.
Precautions taken in exempted mines, 15337.
Extent of watering, 10542, 10659, 10830, 11170, 11815.
Hose and stand-pipe system, 10198, 10200, 10671, 17930.
Meissner, Herr, paper on, 16094.
Physical conditions favourable to, 13559.
Qualifications of man having charge of watering, rule as to, 10514, 10536.
Report by Dr. Haldane and others on, 16112A (*par.* 8), 17231.
Sprays and stand-pipe system, 10173 (*par.* 23), 10476.
Temperature of mines, effect on, 18893.
Timbering, effect on, 13571, 14149.
Westphalian Mines:
Ankylostomiasis, 11270.
Character as to dust, 15175.
Experimental gallery, 10968.
Watering, 10512, 10517, 11270, 13559, 15090.
Cost, 10624, 10629.
Exemptions, system of, 10506, 15171 (*par.* 16), 15256, 15328, 15337, 15440.
Qualifications of man having charge of watering, 10514.
Report on, 16112A (*par.* 8), 17231.
Timbering, effect on, 14149.

Glamorganshire: Witness giving evidence for—Mr. Hannah. (*For separate index to his evidence, see Index II.*)

Glyn Explosion, cause of, 13228.

Granville Colliery Explosions, 12734, 12745.

Haulage:
Accidents, 14182A (*par.* 6), 14254, 18821, 18822, 19262.
Scotland, *see that title.*
Watering would probably increase danger of, 14182A (*par.* 6), 14253, 14320, 14323, 19095A (*par.* 15), 19260.
Dust accumulation in relation to, 10546 (*par.* 39 *et seq.*), 10591, 10726, 10903, 14182A (*par.* 6), 14210, 15171A (*par.* 15), 15249, 15677, 15695, 16112A (*par.* 2), 16130.
(*See also title* Wagons, *sub-heading* Dust from.)
Inclination of roads, 18809.
Mechanical haulage, increased use of, in Knowles & Co.'s collieries, 18855.
Preferable to horse haulage, 18859.
Safety gates introduced in South Yorkshire collieries, 15171A (*par.* 9).
Wagons, *see that title.*

Inspection of Mines by Mines Officials:
Dust, inclusion in reports, suggestion as to, 18568.
Falls of small pieces of roof, precautions as to, question as to, 14333.
Number of inspections, 12919A (*par.* 19), 13028.

Intercommunication, extension, danger of, shown in Courrières disaster, 10954.

Lancashire: Witnesses giving evidence as to—Mr. Bramall, Mr. Peace and Mr. Pilkington. (*For separate indexes to their evidence, see Index II.*)

Lianerch Explosion, cause of, 13228.

McLaren Explosion:
Cause of, 12648, 13228, 14117, 15425, 19574.
Zone, dustless, question whether explosion might have been arrested by, 15433.

Managers:
Certificate of competency, examinations for, 17772.
Central Board advocated, 16368A (*par.* 1), 16375, 16376, 16389, 16466, 16475, 16479, 16489.
Classes, first and second, suggestions as to, 16488.
District Boards, number of, views as to reduction of, 16368A (*par.* 1), 16375, 16468.
Power of Home Office to reduce number without altering the law, 16461.
Number of examinations yearly, views as to, 16470.
South Kensington examination system, 16381, 16464.
Uniformity of system and of questions, views as to, 16368A (*par.* 1), 16375, 16380, 16462, 16479, 16486, 16489.

Managers—*cont.*
Certificate of competency, &c.—*cont.*
Viva voce local examinations, views as to, 16368A (*par.* 1), 16375, 16379, 16386, 16479, 16482.
Responsibility of, 13245, 17762, 17906.
Shot-firing, notice to and permission from manager, suggestions as to, *see title* Shot-firing, *sub-heading* Notice to Manager and Permission from him.

Merthyr Explosion, cause of, 12160, 14114.

Michlifield Explosion, arrest of before reaching face, 18545, 18546.

Midland District: Witnesses giving evidence as to—Mr. Bragge and Mr. Todd. (*For separate indexes to their evidence, see Index II.*)

Miners' Nystagmus, number of men suffering from, in safety lamp mines and naked light mines compared, 15719.
Electric lamps would probably remedy this, 15747.
Serious character of disease, question as to, 15757.

Miss-fire shots, *see title* Shot-firing

Monmouthshire and South Wales: Witnesses giving evidence as to—Professor Galloway, Mr. Hannah and Mr. Routledge. (*For separate indexes to their evidence, see Index II.*)

Nottinghamshire: Witness giving evidence as to—Mr. Fowler. (*For separate index to his evidence, see Index II.*)

Oaks Explosion, dust probably the cause of, 14384, 16704, 16878.

Ocean Collieries, explosion at, when no men were in pit, 19557.

Owners:
Attitude of, as regards measures to increase safety of men, 14362, 14426, 15004, 15171A (*pars.* 9, 10 and 11).
Watering of mines, freedom to adopt alternative system, views as to whether desirable, 11674, 12505, 12864, 12870, 12873, 13947, 14017, 14843, 15035, 15171A (*par.* 12), 15230, 15255, 15293, 15311, 15434, 18450, 18717.

Park Slip Explosion, damp floor traversed by, 10496.

Paving—*see title,* Zones, *sub-heading* Paving.

Penygraig, Explosion at, 13646.

Pillars of Coal:
Arches, pillars of coal for support of, views as to whether desirable, 12777, 12910, 13331, 13499.
At bottom of pit, 12540, 12623, 12774.

Pneumatogen (Rescue Apparatus):
Cost of, 19006.
Heat given off by, 19004.
Vomiting induced by, 19001.
Weight of, and work that can be undertaken by man wearing, 18989.

Pneumatopher, *see title* Rescue Work and Appliances, *sub-heading* Breathing Apparatus.

Pochin Colliery:
Explosion, arrest of, by slightly damp roadway, 10173 (*par.* 26), 10204.
Steam in down-cast shaft, 10173 (*par.* 44), 10305.

Pontypridd Officials' Association, dust removal, consideration by, 12569, 12581.

Railway Trucks, dust from, amount of, as compared with dust from wagons in coal mines, 10173 (*par.* 6), 10184, 10343.

Rescue Work and Appliances:
Altofts Colliery, Mr. Garforth's experimental station at, 15792, 18914A (*par.* 7).
Plan of, 15792.
Tests held at, 18914A (*par.* 8), 18924, 19061.
Breathing Apparatus:
Comparative merits of different kinds, summary of, 18943, 19077, 19086.
Danger of use of, unless apparatus is in perfect order and in hands of properly trained men, 18914A (*par.* 12), 18945, 18946.
Draeger apparatus, *see that sub-heading.*
Hunger induced by wearing, 18914A (*par.* 10), 18932.
Medical examination of men before training advocated, 19043.
Paper on, by Witness, 18914A (*pars.* 3 and 5).
Pneumatogen, *see that sub-heading.*
Responsibility for, 18953, 18966, 18972.
Rust, danger of, and method of prevention, 18940.
Stations, suggestions as to, *see sub-heading* Stations.
Testing before use, importance of, 18949, 18958, 18980, 19009, 19036.

Digitized by Google

Rescue Work and Appliances—*cont.*
Breathing apparatus—*cont.*
Training of men in use of, suggestions as to, 17483, 18458, 18914A (*par.* 13), 18949, 18968, 18980, 19016, 19030, 19054.
Cost of, 19030.
Length of training, 19033, 19043.
(*See also sub-heading* Stations.)
Utility of, views as to, 17236, 17359, 17360, 17478, 18459, 18558.
"Weg" apparatus, *see that sub-heading.*
County Council, aid not given by, in lectures, &c., instance of, 16678.
Courrières Mine disaster, death of man wearing breathing apparatus, 19018, 19091.
"Draeger" breathing apparatus:
Comparative merits of Draeger and other apparatus, summary of, 18943.
Distinction between Draeger and Weg apparatus as regards oxygen feeding, 19077, 19086.
Filling by means of high-pressure pumps, 18941
Hunger induced by use of, 18932.
Mouth-breathing and helmet-breathing systems described, 19075.
Removal by man himself, possibility of, 19090.
Temperature of mine, effect of, on, question as to, 19093.
Tests:
Breakdown during tests, instance of, 18924, 18929.
Duration tests, 18914A (*par.* 10), 18931, 19074.
Work done by man wearing apparatus, 18914A (*pars.* 8, 10 and 11), 18924, 18933, 19061.
Training men in use of:
Cost of, 19030.
Length of training, 19033, 19043.
Weight of, 19059, 19088.
Westphalia, adoption in, at Gelsenkirchen, 18937.
"Fleuss" apparatus, experience with, 18457, 19071.
Germany, rescue work and appliances in:
Attitude of Government towards, 18914A (*par.* 16), 18985.
Draeger apparatus, adoption at Gelsenkirchen, 18937.
Giersburg apparatus, 18914A (*par.* 3).
Shamrock Colliery, apparatus at, 18914A (*par.* 3), 18919, 18939, 19070.
Giersburg apparatus, 18914A (*par.* 3), 18919.
Pneumatogen:
Cost of, 19006.
Heat given off by, 19004.
Vomiting resulting from use of, 19001.
Weight of, and work that can be undertaken by man wearing, 18989.
"Shamrock" apparatus, 18914A (*par.* 3), 18919.
Headache caused by use of, 19070.
New type of apparatus, 18939, 18940.
Stations at which apparatus could be kept, experiments made, and men trained, suggestions as to, 10546 (*par.* 73), 17485, 18458, 18460, 18560:
Central stations for groups of collieries, suggestion as to, 18914A (*par.* 13), 18948, 18953, 18968, 18977, 19054, 19064.
Cost of, 19030, 19049:
Method of defraying, 19023.
Distance from collieries need not be a disadvantage, 18955, 18968.
Gallery necessary for training men, 19047.
Inspection by H.M. Inspector of Mines advocated, 18914A (*par.* 17), 19013.
Midland Institute of Mining Engineers, establishment of stations considered by, 18914A (*par.* 2).
Model station, plate illustrating, and estimate of cost of, 19049.
Number of men required at, 19021.
Number of sets of breathing apparatus to be kept at, 19019.
Papers on, by Witness, 18914A (*pars.* 2, 3 and 5), 18917.
Plan of, 19049.
Position of, views as to, 19023.
Postponement of provision until Report of this Commission, probability of, 18914A (*par.* 11).
Responsibility for, 19031.
Scheme of working described in detail, 18969, 18980, 19009, 19066.

Rescue Work and Appliances—*cont.*
Stations at which apparatus, &c.—*cont.*
Central Stations—*cont.*
Tankersley Rescue Station, *see that sub-heading.*
Tankersley Rescue Station, 18914A (*pars.* 1 and 4).
Apparatus used at, 18914A (*pars.* 3 and 9), 18919.
Cost of working, 19030.
Method of defraying, 19023.
Plan of, 19046.
Scheme of working described, 19023.
Sole joint colliery rescue station in England, 18914A (*par.* 16), 18921.
Tests at, record of, 18914A (*par.* 9).
Training of men at, 18914A (*par.* 4).
"Weg" apparatus, 15617A.
Description of, 15791 *et seq.*
Distinction from "Draeger" apparatus as regards oxygen feeding, 19077, 19086.
Safety lamp carried by men wearing, 15728, 15818.
Standardising of valve advocated, 15802.
Still in course of development, 18937, 18943, 19062.
Tests:
Breakdown during, 18924, 18929.
Duration tests, 19074.
Work done by men wearing apparatus, 15799, 15802, 18914A (*par.* 8), 18924.
Training of men in use of, 15805.
Weight of, 15795, 15802, 15814, 19059, 19088.

Royal Commission on Coal Dust, *see title* Commission, Royal.

Safety Lamps:
Act of Parliament: Coal Mines Regulation Act, 1887, Sec. 49, General Rules, 14629, 14632, 14647, 14751, 14753, 14876, 15234, 15381, 18470, 18474.
Compulsory introduction of, views as to whether desirable, 14641, 14667, 15171A (*par.* 12), 15231, 15255, 15293, 15381.
Inspectors, power of, as to introduction, 15311.
Report on watering in Westphalian mines, suggestion contained in, 17231.
Defects of present types, 15700, 15767, 16261.
Electric Lamps:
Advantage of, 15726, 15747.
Batteries, improvement in, 15770.
Collieries using, 15769.
Defects in lamp, summary of, 15730, 16261.
French collieries: arrangement with Electric Light Company as to provision and maintenance of, 15750.
Ventilation, defective, indication of, not furnished by, 15738, 16262, 16315.
Apparatus by which gas may be detected, 15740, 15786, 16265, 16315.
"Weg" life-saving apparatus, electric lamp used by man wearing, 15728, 15818.
Explosions in relation to, 10426, 10448, 10546 (*pars.* 5, 26 and 72), 10547, 10712, 10716, 12734, 13261, 13262, 14603, 14628, 14666, 15422, 16047, 17337, 17339.
Slight fall of roof breaking glass, explosion caused by, 13333.
Extent to which used, 11479, 12739, 14942, 15448A (*par.* 2), 15769, 16059, 16361, 16394, 17339.
Scotland, *see that title.*
Gauzes, single, prohibition advocated, 10546 (*par.* 72), 10713.
Locked lamps, use of, 15238, 19389.
Miners' Nystagmus, number of men suffering from, in mines using safety lamps, as compared with mines using naked lights, 15719.
Electric lamps would probably remedy this, 15747.
Serious character of disease, question as to, 15757.
Number of lamps in proportion to number of men, 15711, 15758, 15760.
Objection on part of men to introduction of, frequency of, 15237.
Oils for, 15937A (*par.* 14), 15970, 15977, 16036.
Power of, 15699, 15937A (*par.* 14).
Relighting, 15710, 15766.
Safety of, views as to, 18470.
Scotland, *see that title.*
Special Rule in force in Lancashire, 14764, 15238.
Testing lamps and types of lamps, 10546 (*par.* 72), 10713, 10990, 15756.
Types of lamps, 15700, 15767, 15971, 15972.
Rhodes, Mr., experiments of, 18255A (*pars.* 1 and 9), 18262.

Digitized by Google

Safety Lamps—*cont.*
Ventilation, defective, indications of, 15723, 15739, 15970, 15977, 16035.
Watering, compulsory, in mines in which safety lamps are used, views as to, 15937A (*par.* 9).

Schools, Elementary, instruction of children in, in matters concerning mining, suggestions as to, 14459A (*par.* 22), 14849, 14887.

Scotland:
Accidents:
Number of, from falls of roof and sides, and from haulage, 18020, 18028, 18177.
Return showing excess over number of explosions, 17548 (*par.* 10), 17573.
Safety lamps, use of, would probably increase number of these accidents, 17548 (*par.* 9), 17576, 17684, 17713, 17759, 17904, 17932, 18025, 18174.
Report of, regulations as to, 17679, 17683, 17950.
Barwood Colliery explosion, Kilsyth, cause of, 17548 (*par.* 4).
Blantyre Colliery explosion, *see title* Blantyre.
Dust in mines:
Character of Baird & Co.'s collieries and of Scotch collieries generally as to dust, 17831, 17915, 17924.
Danger from:
Extent to which realised and dealt with, 17548 (*pars.* 1, 2 and 3), 17550, 17937, 17979A (*par.* 2), 17991.
Not very serious in Scottish mines, 17548 (*pars.* 7 and 14), 17996, 18135.
Exemption of mines from stringent regulations advocated, 17548 (*par.* 21), 17618.
Explosions of dust, 17554, 17979A, 17981, 18137. (*See also titles* Denny Explosion and Blantyre Explosion.)
Inflammability of various kinds of coal dust:
Difference of opinion between management and inspectors as to, 17548 (*par.* 14).
Galloway, Mr., analysis by, 17548 (*par.* 14), 17589.
Hall, Mr., analysis by, 17548 (*pars.* 11 and 13), 17556, 17567.
Prevention:
Brushing away:
Amount of dust that would probably be left, and questions as to whether sufficient to cause an explosion, 17613, 17696.
Zones (dry), arching, difficulty as to, 17896.
Screening-plant, dust from:
Danger from, small, owing to dampness of shaft, 17548 (*par.* 23) 17661.
Prevention of, by fans or other methods, not considered, 17662.
Explosions:
Experience of Witness as regards, 17727.
Firedamp, number of explosions from, 17548 (*par.* 9).
Ignitions of gas, as distinguished from explosions, 17704, 17741, 17939, 18193, 18199, 18205.
Brushing out of gas very little practised:
Hurdle-screens occasionally put up, 17935, 17943.
Number of, and death-rate from explosions, 17548 (*pars.* 4 and 7), 17573, 17680, 17685, 18016, 18137, 18186.
Small explosions occurring chiefly in open light mines, number of, 17548 (*par.* 7), 17570, 17679, 17699, 17736, 17742, 18197, 18202, 18206.
Report of, law as to, 17680, 17683, 17950, 18190, 18202.
Explosives, permitted:
Baird & Co.'s Collieries, 17958.
Drumpeller Colliery, use of Roburite at, 17982.
Storage in miners' houses, objection to, 17961, 17969.
Summerlee Colliery, explosives used at, 18098, 18100.
Supply by owners to men advocated; objections to men purchasing from any licensed shop, 17961, 17970.
Explosives Order, adequacy of, views as to, 17617.
Points in which strengthening is desirable, 17619.
Foreign workmen, employment of (Bothwell Park Colliery), 17794.

Scotland—*cont.*
Gradient of steep mines, 17693, 17711.
Haulage accidents, number of, 18020, 18028, 18177.
Would probably be increased by introduction of safety lamps, 17760, 18029.
Ignition of gas:
Distinct from explosions, 17704, 17741, 17939, 18193, 18199, 18205.
Number of, 18199.
Prevention, measures for, 17935, 17943.
Notice of Accidents Act, as to report of accidents, 17953.
Price of coal at pit-mouth, 17979A (*par.* 9).
Safety lamps:
Accidents from falls of roof and sides, and from haulage, number of, would probably be increased by introduction of safety lamps, 17548 (*par.* 9), 17576, 17684, 17713, 17722, 17759, 17904, 17932, 18015, 18023, 18174.
Compulsory introduction of, in mines where watering or brushing away are impracticable, views as to, 17903, 17979A (*par.* 6), 18014, 18033, 18036, 18039, 18158.
Explosions, number of, in mines where safety lamps are not used, 17548 (*par.* 7), 17570, 17575, 17679, 17699, 17704, 17736, 18197, 18202, 18206.
Extent to which naked lights are used as compared with safety lamps, 11481, 17548 (*par.* 6), 17719, 17737, 17756.
Number of lamps in proportion to number of men, 17694.
Objection to introduction of, both on part of owners and men, 17715, 17812.
Re-lighting, difficulty of, 17691.
Return to open lights after introduction of safety lamps, question as to, 17814.
Stoep workings, increased use of safety lamps in, undesirable, 17689, 17711.
Types advocated and types used, 17791, 17918.
Shot-firing:
Abolition of, views on this point, 17548 (*par.* 18), 17902.
Acts, Orders, Regulations on:
Adequacy of, if strictly observed, 17548 (*par.* 21), 17887, 17979A (*par.* 6), 18014, 18033, 18120, 18124, 18158.
Detonators, conditions as to use of, 17885.
Drilling, stemming and blasting, regulations as to, 17850, 17852.
More explicit directions, views as to whether desirable, 17858.
Face and haulage roads, different method of dealing with, under, 17845.
Between shifts:
At night in main haulage roads and in stonework, views as to, 17548 (*par.* 18), 17595.
Prohibition of shot-firing except between shifts impracticable in many mines, 17548 (*par.* 18), 17979A (*par.* 6), 18014, 18033, 18120, 18158.
Stoop and room workings, two shots fired by hewers themselves during shifts, 18102.
Electrical firing apparatus or fuse, 17883.
Extent of, in stoop and room workings, 18113, 18228.
Face, no danger from shot-firing in; danger occurs in haulage roads, 18089, 18097.
Former method, 18230.
Miss-fire shots:
Danger arises chiefly from, 17487, 18163, 18232.
Explosion at Drumpeller, 17981.
Special Rule as to marking out direction of shot, views as to, 17863, 17868.
Withdrawal of men, views as to, 17869.
Notice to manager and permission from him before shot is fired in main haulage road, views as to, 17548 (*par.* 19), 17601, 17877, 18039, 18122, 18159.
General Rule advocated, 17603.
Number of shots to be fired simultaneously, views as to, 17871.
Penalties for infringement of rules, increase advocated, 17623.
Person firing shots, 18172, 18241.
Appointment of: question of competency left to manager; certificate unnecessary, 17761, 17905.
Drilling holes, stemming, and charging shot should be supervised by shot-firer himself, 18160, 18166.

Digitized by Google

Scotland—*cont.*
Shot-firing—*cont.*
Persons firing shots—*cont.*
Limitation of shot-firing to, views as to, 17663, 17668.
Instruction of, 17091, 18168.
Permitted explosives, appointment in cases of use of, 17880.
Safety-lamp mines, all shots in fired by officials, 18115.
Single individual not to carry both explosive and means of firing it; views of Witness as to this suggestion, 17624, 17674, 17884, 18042, 18054.
Stoop and room workings, 18115.
Ripping or brushing shots, 18062, 18106, 18241, 18248.
Employment of men firing, by contractors or company, 18244, 18252.
Solid, firing in, 18229, 18231.
Watering in neighbourhood of a shot:
Area to be watered, increase, views as to, 17621, 17676, 17810, 17876, 17888, 18045.
Difference of opinion between inspectors and management as to necessity for, 17548 (*pars.* 14 and 15).
Ventilation:
Explosions occurring in mines where gas has been found and reported, 17746.
Ignition of gas, distinction from explosion, 17704, 17741, 17939.
Brushing out of gas very little practised; hurdle screens sometimes erected, 17935, 17943.
Wagons:
Dust-tight, type advocated, &c., 17548 (*par.* 8), 17604.
Lighting, 17582, 18032.
Repair of, 17610.
Compulsion as to, views as to, 17611.
Water, natural, in pits, 17548 (*par.* 8), 17919, 17979A (*par.* 5), 18006, 18147.
Watering:
Compulsory universal, objections to, 17548 (*par.* 17), 17590, 17979A (*par.* 6).
Character of mine in which possible, 17917.
Dangers and difficulties of, effect on roof and sides, 17979A (*par.* 5), 18151.
Experience of witness as to, 17931.
Zones, suggestions as to, 18010, 18120.
Arching, difficulty of, 17896, 18011, 18153, 18235.
Arrest of explosion by, instance of, 18222, 18224.
Length of, 18009.

Screening-Plant, dust from, *see title* Dust, *sub-heading* Prevention or Removal of—Screening-Plant.

Seaham Colliery Explosion:
After-damp, death of man from, accelerated by efforts of rescuers, 17354.
Cause of, 13227, 13261, 14103, 14406, 14479.
Course traversed, 14105.
Rescue apparatus, use of, in restoration of ventilation, 17360.
Visit of Professor Galloway to the colliery after the explosion, 10470.

Seaton Colliery Explosion, greatest violence against air-current, 16749.

Shale Dust, inability to carry an explosion, 10358.
Abel, Sir F., experiments by, 10361, 10363.

Shot-firing:
Abolition of:
Advisability of: views on this point, 10420, 10432, 10864, 13431, 13968, 14111, 14123, 14679, 14840, 15589, 16045, 16977, 17225, 17227, 17374, 17443, 17902, 18255A (*par.* 2 *et seq.*), 18275, 18314.
Collieries in which abolished as far as practicable, 10439, 14835, 15171A (*par.* 14), 15367, 15589, 15615, 16982, 17227.
Accidents caused by, 14265, 19217.
(*See also sub-heading* Explosions.)
Acts, Orders, Regulations, &c.:
Adequacy of, views of Witnesses on this point, and as to strengthening, 10250, 10546 (*par.* 71), 12136A (*par.* 7), 12481, 12492, 12808, 12819, 12830, 13024, 13130, 13168, 13213, 13218, 13428, 13432, 13662A (*par.* 16), 13775, 13807, 13955, 14182A (*par.* 8), 14265, 14894A (*par.* 7), 14969, 15171A (*par.* 18), 15369, 15371, 15617, 15830, 15885, 15963, 15996, 16052, 16110, 16408, 16411, 16629, 16649, 16688, 16689, 16714, 16720, 16825, 16883 (*par.* 7), 17061, 17219, 17230, 17234, 17279, 17294 (*par.* 9), 17296, 17858, 17887, 18281, 18425, 18427, 18683, 19559.
(*For particular suggestions as to Rules, &c., see sub-headings* Person Firing Shot; Notice to Manager, &c.)
Codification and simplification of rules, views as to necessity for, 10546 (*par.* 71), 10689, 14517, 14574, 16409, 16572, 16580, 18683, 18694.
Extent to which explosions might be prevented by strict observance of existing rules, 10424, 10546 (*pars.* 26, 70 and 71), 10751, 10755, 10882, 11123, 11125, 11199, 11218, 11331A (*par.* 6), 11385, 11468, 11571, 11639, 13022, 13024, 13129, 13167, 13171, 13213, 13662 (*par.* 14), 13763, 13773, 14112, 14182A (*par.* 6), 14239 14295, 14316, 14407, 14459A (*par.* 20), 14999, 15311, 15937A (*par.* 12), 16407, 17401, 18255A (*par.* 10), 18722.
French rules less stringent than English, 10957.
Different methods of dealing with shot-firing at face and in haulage roads, under Acts and Explosives Order, 17845.
Distinction drawn between naturally wet and artificially wet mines, 14690.
Notices warning all men working underground of danger of non-compliance with rules, 17294A (*par.* 10).
Watering in neighbourhood of a shot, regulations as to, *see sub-heading* Watering in Neighbourhood of a Shot.
Between shifts:
Practice as to in various collieries, 11539, 12821, 12828, 13282, 15100, 15171 (*pars.* 14 and 18), 15243, 18255A (*par.* 6), 18276, 18358, 18580A (*par.* 9), 19332.
Prohibition of shot-firing except between shifts, views as to whether practicable or desirable, 10608, 10702, 11103, 11212, 11416, 11520, 11533, 11634, 11837A (*par.* 11), 11961, 11980, 13282, 13662A (*par.* 14), 13785, 15101, 15171A (*par.* 18), 15244, 15371, 16110, 16112A (*par.* 18), 16206, 16215, 16883A (*par.* 7), 16965, 16974, 17212, 18549.
Ripping shots, 18255A (*par.* 7), 18277, 18543.
Blown-out shots, explosions in relation to, 13261, 13264, 13288A (*par.* 2), 13391, 13467, 13662A (*par.* 14), 13674, 13686, 13892, 14065, 14894A (*par.* 7), 15411, 17518, 17847, 18255A (*par.* 1), 18266, 18685:
Cause of, and necessity for prevention of blown-out shots, 10546 (*par.* 71), 12104, 13264, 14858A, 18547, 19373.
Drilling, stemming and tamping shots, *see sub-heading* Drilling, &c.
Number of, 13267, 14069, 14070, 14080, 14083, 15962, 19369.
Refusal to fire shot if there is danger of a blown-out shot, suggestion as to, 18463.
Cartridges, *see sub-heading* Water Cartridges.
Charge, amount of, 10546 (*par.* 71), 10704, 16653, 16654, 16728, 16775.
Coal-cutting machinery, increase in practice of shot-firing since introduction of, 11963, 12106, 19463, 19595.
Detonations, variations as to danger, theory as to, 12653A (*par.* 2), 12671, 12694.
Detonators:
Conditions as to use of, under Explosives Order, 17884.
Defective detonators, percentage of, 16447, 18289.
Testing, 18292, 19344, 19414.
Drilling, stemming and tamping:
Act of Parliament, regulations as to, in, 17852, 17858, 19370.
Coal dust, stemming with, danger of, 14858A.
Diameter of hole, experiments as to, advocated, 16010.
Importance of, 12803, 12818, 12880, 16002, 18255A (*par.* 8), 18295, 18432.
Instruction to shot-firer not to light shot unless preparations are satisfactory; practice as to in Knowles & Sons' collieries, 18696.
Person drilling holes, 18432, 18462, 18580 (*par.* 8), 18622, 19332, 19356, 19362, 19435.

Digitized by Google

Shot-firing—*cont.*
Drilling, stemming and tamping—*cont.*
Solid, boring in, 12881, 19619.
Special or General Rules, views as to whether desirable, 18436, 18686, 19362, 19436.
Unstemmed shot, danger of as compared with miss-fire shot, 16002.
Experiments, suggestions as to, *see title* Experiments, *sub-heading* Shot-firing.
Explosions in relation to, 10313, 10315, 10371, 10546 (*par.* 70), 10711, 10751, 11837A (*par.* 11), 11858, 12104, 12173, 12598, 13226, 13261, 13264, 13288A (*par.* 2), 13391, 13467, 13662A (*par.* 13), 13674, 13686, 13892, 14065, 14401, 14406, 14506, 14594, 14785, 15171A (*par.* 13), 15296, 15366, 15894, 15937A (*par.* 13), 15962, 17294A (*par.* 3), 17339, 17518, 17521, 18255A (*par.* 1), 19216.
Blown-out shots, *see that sub-heading.*
Number of explosions due to shot-firing in last ten years, 10546 (*par* 70).
Unknown quantity in circumstances which cause explosion, 15937A (*par.* 2).
(*See also sub-heading* Acts, Orders, Regulations—Extent to which Explosions might be Prevented by Strict Observance of.)
Explosives, *see that title.*
Explosives Order, *see that title.*
Extent to which practised in various collieries, 11102, 11123, 11133, 13662A, 13764, 13957, 15941, 16057, 16061, 16209, 18255A (*pars.* 2, 3, 4 and 5), 18273, 18279, 18365, 18580A (*par.* 9), 18684.
Face, shot-firing in, 10763, 10859, 11128, 11521, 11534, 12799, 12801, 13273, 13274, 13286, 13288, 16351, 16353, 16438, 16455, 16684, 17845, 19329, 19340.
Falls and packing of timber, Shot-firing in neighbourhood of, 12498, 12599.
Fiery mines, prohibition in, unnecessary if permitted explosives only are used, 13968.
Fuses, electric, 12815, 16404, 16446, 16491, 17883, 18580 (*par.* 8), 19342, 19387.
Limitation of number of men in mines during, suggestion as to, 11331A (*par.* 6), 11416, 13662A (*par.* 14), 13785, 16978, 18281.
Miss-fire shots:
Detonators, search for, advocated, 16405.
Direction of shot, marking out, Lancashire Special Rule as to, 17863, 17868.
Electric fuses, use of, in relation to, 16404, 16446, 16491, 18675.
Interval to elapse before another shot is fired, and prohibition of men from approaching place where miss-fire has occurred, views as to, 16404, 16449, 16454, 17869, 18287, 18294, 18428, 18506, 18675, 19343.
Rarity of miss-fire shots in certain collieries, 19343, 19414.
Record of, by firemen, in Ferndale Collieries, 19420.
Unramming a shot, Durham Special Rules as to, 14796.
(*See also sub-heading* Explosions.)
Notice to manager or under-manager and permission from him before shot is fired, practice as to, in certain collieries, and views as to whether General Rule as to is desirable, 10706, 11102, 11123, 11217, 11837A (*par.* 11), 11976, 12080, 12494, 12832, 13131, 13139, 13142, 13169, 13187, 13192, 13232, 13260, 13433, 13438, 13972, 14268, 14409, 14459A (*pars.* 25 and 32), 14553, 14649, 14655, 14774, 14894A (*par.* 7), 14982, 15372, 15841, 15937A (*par.* 13), 15963, 16307, 16774, 16775, 16779, 16883 (*par.* 7), 17146, 17151, 17218, 17290, 17294A (*par.* 9), 17877, 18300, 18427, 18580A (*par.* 9), 18633, 18634, 18639, 19336.
Number of shots to be fired simultaneously and views as to limitation to one, and examination of place between each shot, 14784, 14894A (*par.* 7), 14969, 15034, 15376, 15674, 15833, 15838, 17294A (*par.* 1), 17497, 17871, 18283, 18507, 18510, 18679, 19346, 19349, 19353.
Act of Parliament regulating, 14787.
Ashton, shot-firing at, instance of necessity for this examination, 15840.
Person firing shot:
Appointment of special official or man, practice in this respect, and views as to whether desirable, 10709, 11129, 11539, 11634, 11637, 12825, 12833, 13662A (*par.* 14), 13780, 13803, 13958, 14055, 14058, 14273, 14313, 14650, 14780, 15844, 15937A (*pars.* 13 and 14), 16044, 16069, 16353, 16455, 16493, 16693, 17290, 17294A (*par.* 9), 17298, 17448, 17880, 18580A (*par.* 8), 18622, 19332, 19377, 19380, 19560, 19616, 19618.

Shot-firing—*cont.*
Person firing shot—*cont.*
Appointment of special official or man—*cont.*
Certificate for shot-firer, views as to whether desirable, 15937A (*pars.* 13 and 14), 15963, 15966*, 16000, 16045, 16064.
Board of examination in event of, 15967, 16067.
Managers' responsibility renders certificate unnecessary, 17905, 18698, 18835, 18836.
Instructions to, supply of copies of rules and regulations, &c., 16064, 16069, 16353, 16357, 16569, 16570, 16575, 16796, 16830, 16861, 17221, 17223, 17343, 18690, 18694, 19376.
Record of number of shots, &c., 17294A (*par.* 10), 17415, 19420.
Safety lamps, mines in which used, special man for shot-firing in, advocated, 17294A (*par.* 11), 17446, 17452, 17464.
Single individual carrying both explosive and means of firing it; prohibition of, views as to whether desirable, 16883 (*par.* 7), 17279, 17289, 17299, 17314, 17321, 17456, 17884, 18522, 18701.
Refuge holes, construction of, shot-firing during, 15592.
Ripping shots, 13769, 18255A (*par.* 7), 18277, 18543.
Roadways, main haulage, shot-firing in, 10313, 10371, 11123, 11261, 11579, 12136A (*par.* 7), 12173, 12309, 12599, 12821, 12825, 12832, 13662A (*par.* 16), 13775, 13760, 13766, 13807, 13965, 14124, 14402, 16683, 16686, 17294A (*par.* 4), 19336.
(*See also sub-headings* Abolition *and* Between Shifts.)
Scotland, shot-firing in, *see title* Scotland.
Small coal left in gob, shot-firing in relation to, 11133.
Special Rules, 12653A (*par.* 6), 14796, 16581, 16692, 16780, 18580A (*par.* 8), 18621, 18633.
Lancashire Special Rules, 13192, 13972, 14982, 15034, 16307, 17602, 17863, 17868, 18580A (*par.* 8), 18621, 18633.
Midland District, 12653A (*par.* 6).
(*See also sub-heading* Acts, Orders, Regulations, &c.)
Temperature of explosion of shot, enquiry into effect of, with regard to explosions, suggestions as to, 11331A (*par.* 7), 11426.
Training men in use of permitted explosives, 15982, 16072.
Ventilation in relation to, 11579, 17294A (*par.* 8), 18526.
Vortex rings, 10252, 10264, 10272, 10287, 10330, 10337, 10384, 11428, 15937A (*par.* 2), 15943, 16010, 16086.
Water cartridges, use of, 16216, 16221, 16339, 16346, 18519.
Account of method of use, 16346.
Gunpowder, use of, with, inadvisable, 16342, 16364.
Leakage, possibility of, if cartridge is not fired at once, 16367.
Miss-fire shot, 16341.
Royal Commission of 1891, evidence as to, before, 16342.
Sample of, 16224.
Watering in neighbourhood of a shot:
Act of Parliament: Coal Mines Regulation Act, General Rules under, 14684:
Distinction drawn in, between naturally and artificially wet mine, 14690.
General Rule 12, as to, 10691, 11099, 11123, 11571, 11968, 14684, 14894A (*par.* 7), 15670, 18418.
Observance of, views as to, and as to importance of, 10689, 10696, 11097, 11331A (*par.* 6), 11397, 11446, 11571, 11966, 11977, 12136A (*par.* 7), 12498, 13022, 13130, 13142, 13270, 13662A (*par.* 14), 13781, 14407, 16698, 17294A (*pars.* 8 and 9), 17334, 17339, 17366, 18048, 18121, 18255A (*par.* 10), 18297, 18422, 19353.
Advantage of, as compared with watering of whole of wagon ways, 10328.
Amount of water required, 10328, 11397, 11405, 11452, 12136A (*par.* 7), 16190, 18311, 18553.
General Rule 12, requirements of, as to, 15670, 18418.
Area to be watered, and views as to whether extension is desirable, 10251, 10273, 10327, 10700, 11123, 12136A (*par.* 7), 12498, 17621, 17810, 17876, 17887, 18306, 18681, 19213, 19355.
Complete clearing of dust, views as to whether possible, 12021, 12309.
Decision as to, person to be responsible for, 18300.
Engine planes, shot-firing in, watering in cases of, 16413.

Digitized by Google

Shot-firing—*cont.*
Watering in neighbourhood of a shot—*cont.*
Examination for dust, necessity for, 19353.
Face, watering at, 13273, 18364.
Headings near face, 10308.
Methods of, consideration of, 10173 (*par.* 43), 10247, 10334, 11403, 11414, 11451.
Midland District, Special Rule, 12653A (*par.* 6).
Possibility of, in most mines, 13431.
Practice as to, in certain collieries, 15594, 15670, 16413, 16642, 16644, 16766, 19213.
Testing efficiency of watering before shot is fired, question as to, 18556.
Zones, watered, shot-firing in relation to, 10225, 13431, 13754, 13756.
(*See also title* Explosions.)
Small Coal :
Dust accumulation from, 11227.
Gob, small coal left in, 10760, 10786, 11133, 14173.
South Wales and Monmouthshire : Witnesses giving evidence as to—Professor Galloway, Mr. Hannah, Mr. Hood and Mr. Routledge. (*For separate indexes to their evidence, see Index II.*)
South Yorkshire Collieries : Witnesses giving evidence as to—Mr. Chambers and Mr. Rhodes. (*For separate indexes to their evidence, see Index II.*)
Southern District, manager's certificate of competency, examination for ; one central Board advocated, 16379
Special Rules :
Adequacy of, and importance of observance of, views as to, 12919A (*par.* 18), 13025, 13211, 13218, 13223, 13256, 14459A (*par.* 29), 14505, 14663, 14865.
Conversion of, into General Rules, advisable in many instances, 13027.
Discussion between owner and men on men's representation, views as to, 14890.
Shot-firing, *see that title, sub-heading* Special Rules.
Simplification and reduction in number of, views as to whether desirable, 14459A (*par.* 30), 14510, 14552, 14562A, 14878.
Spontaneous Combustion, danger of, would be increased by watering, 13792, 14172, 14182A (*par.* 5), 14231, 14395, 14436, 15937A (*par.* 12), 15959.
Staffordshire, North : Witness giving evidence as to—Mr. Henshaw. (*For separate index to his evidence, see Index II.*)
Talk-o'-th'-Hill Colliery Explosion : Arrest of by non-inflammable dust and wet zone, 10546 (*par.* 17).
Analysis of dust, 10546 (*par.* 17), 10556, 10798, 10808, and Appendix I, *page* 295.
Plan illustrating, 10574.
Tankersley Rescue Station :
Account, general, of working of, 19023.
Breathing apparatus, kinds used, 18914A (*par.* 9).
Plan of, 19046.
Sole joint colliery rescue station in England, 18914A (*par.* 6), 18921.
Tests at, record of, 18914A (*par.* 9).
Training of men at : number trained, &c., 18914A (*par.* 4).
Telephones in mines, 12007, 12014.
Temperature of Mines :
Deep Mines, 14961, 18600, 18608, 18617.
Diagram showing temperature of air on its course through the pit, 18901.
Effect on health of horses, 18854, 18863, 18866.
Effect on health of men, 18871, 18873, 18910.
(*See also title* Watering, *sub-heading* Danger and Difficulties of—Health of Men, Effect on.)
Steam pipes, increase of temperature by, 10374.
Wagons, wooden, shrinkage in very hot temperature, 18642.
Watering, effect of on, and consequent effect on health of men, *see title* Watering, *sub-heading* Dangers and Difficulties of—Health of Men, effect on.
Thorncliffe Colliery Explosion, cause of, 15301.
Timbering :
Accidents, number of, 11299, 11318, 11613, 14564, 15220.
(*See also title* Accidents, *sub-heading* Falls of Roof and Sides.)
Carrying timbers to face, person undertaking, 18476.
Cost of, wet and dry mines compared, 14048.
Creosoted timber, 13030, 13037.
Distance between bars in working face, 11315, 11324.
Special Rules, number of accidents apparently not reduced by introduction of, 14564, 15220.
Time when these accidents usually occur, 11613.
Timbering—*cont.*
Steel or iron props, 11290, 11320, 13718, 16298.
Systems of, 11290, 13718, 13841, 15171A (*par.* 9), 15218, 15684, 15689, 15776, 15781, 16184.
Plates illustrating, 11290, 15692.
Watering, effect of, on, 10413, 11000 (*par.* 15), 11288, 13030, 13571, 13575, 13608, 13715, 13718. 14046, 14147, 14158, 14420, 16112A (*par.* 6), 16157, 16298, 17294A (*par.* 4).
(*See also title* Watering, *sub-heading* Dangers and Difficulties of : Effect on Roof and Sides.)
Timsbury Explosion :
Cause of—shot-firing, 15937A (*par.* 2), 16047, 16086.
Explosiveness of dust proved by, 12653A (*par.* 2, 12678.
Trams, *see title* Wagons.
Truck Act, supply of explosives to men by owners, Act in relation to, 17962.
Udston Colliery Explosion :
Cause of, 17780.
Safety lamp, type used, 17791.
Universal Colliery Explosion :
Cause of, uncertainty as to whether shot-firing, 10317.
Course traversed by, 10467.
Vortex ring caused by shot-firing, 10255, 10258, 10263, 10266.
Urpeth Explosion :
Arrest of, by damp zone, 14459A (*par.* 11), 14491, 14598.
Length of zone, 14824.
Cause of, 14506, 14594, 14785, 17548 (*par.* 4).
Dust analysis, 14712.
Shot-firing Orders and Regulations, uncertainty as to, exemplified by, 14517.
Vacuum Cleaner, use of, for dust removal, views as to, 11000 (*par.* 12), 11090, 11181, 11268, 11837A (*par.* 8), 12136A (*par.* 5), 12210, 12214, 14894A (*par.* 5), 14950, 15881, 16811, 18322, 18453.
Cost of, 11184.
Frequency of use, 11185.
Working of, 11949.
Ventilation :
Act of Parliament regulating :
Clearer definition of "adequate ventilation," views as to, 18526.
Strict observance of, should prevent gas explosions, 13261, 14182A (*par.* 6), 14289, 14459A (*par.* 20), 17402.
Air compressors, 18860.
Fan system, 18650, 18862.
Safety lamps, indications furnished by, 15723, 15738, 15739, 15970, 15977, 16036, 16262, 16315.
Apparatus for use with electric lamps, 15740, 15786, 16265, 16315.
Withdrawal of men, amount of gas justifying, 16040.
Wagons :
Amount of coal held by, and proportion of small coal, 10396, 19582.
Dust from, 10173 (*pars.* 45 and 67), 10183, 10546 (*par.* 34), 10586, 11000 (*pars.* 3 and 5), 11009, 11083, 11331A (*par.* 10), 11837A (*par.* 4), 12136A (*par.* 4), 12653A (*par.* 4), 12700, 12797, 13007, 13147, 13288A (*par.* 3), 13411, 13420, 13662A (*pars.* 6 and 7), 13694, 14142, 14182A (*par.* 4), 14207, 14209, 14307, 14459A (*par.* 18), 14894A (*par.* 1), 15144, 15162, 15448A (*par.* 4), 15464, 15469, 16026, 16112A (*par.* 2), 16130, 16133, 17086, 17093, 17378, 18326, 18492, 18807, 19005A (*par.* 6), 19134, 19141.
Loading, 10587, 10611, 10846A, 10908, 11107, 11461, 11753, 11865, 12195, 12704, 13004. 13008, 13481, 13483, 13662A (*par.* 7), 13694. 13696, 14227, 14230.
Period that wagons will last, 15148.
Repair of, 16887. 16892, 18334, 18477, 18590.
Scotland, *see that title.*
Temperature of mines in relation to, 18642.
Timber, wagons for conveyance of, 18477.
Types of, advantages of dust-tight wagons, &c., 10173 (*pars.* 6 and 7), 10185, 10192, 10341, 10346, 10392, 10546 (*par.* 50), 10586, 10604, 10607, 10731, 11000 (*pars.* 3 and 5), 11009, 11073, 11075, 11105, 11151, 11177, 11223A, 11225, 11236, 11275, 11279, 11288, 11331A (*par.* 11), 11458, 11731, 11750, 11837A (*par.* 5), 11864, 11871, 11875, 11886, 12136A (*par.* 5), 12178, 12194, 12325, 12556, 12703, 12919A (*par.* 16), 13004, 13009, 13142, 13224, 13662A (*par.* 7), 13694, 13696, 14137, 14153, 14178, 14182A (*par.* 5), 14219, 14894A, (*par.* 1), 14896, 15002, 15150, 15163, 15171 (*par.* 15), 15211, 15246, 15276, 15360, 15448A (*pars.* 4 and 5), 15469, 15480, 15602, 16027, 16112A (*par.* 1),

Digitized by Google

Wagons—*cont.*
Types of, &c.—*cont.*
16120, 16329, 16883 (*par.* 1), 16887, 16897, 17086, 17095, 17247, 17548 (*par.* 20), 18327, 18580A (*par.* 1), 18585, 19095A (*par.* 7), 19141, 19477.
Compulsion as to provision of dust-tight wagons, views as to. 10783, 15000.
Cost of, 11881, 15151, 18580A (*par.* 1), 18588.
Crushing of men, danger of, 15472.
Danger of iron wagons on a steep incline, views as to, 16128, 18585.
Ferndale Collieries, type used in, 19095A (*par.* 7), 19141, 19477.
Knowles & Co.'s collieries, type used in, 18585.
Plate illustrating, 18585.
Monmouthshire, type used in, 13004, 13010, 13224.
Plate and sketch illustrating. 11874, 18585.
Screening-plant, modifying of old type of, necessary if doors are to be added to wagons, 12557.
Springs and buffers, views as to, 10173 (*pars.* 6 and 7), 10185, 10346, 10392, 10885.
Cost of, 10395.
Whitwood Silkstone Colliery, type used at, 11837A (*par.* 5), 11871, 12049.
Cost of, 11881.
Sketch of, 11874.
Wingate Colliery, 16794.
Yorkshire, type in, 14182A (*par.* 5), 14219.
Watering coal in wagons, 11331A (*par.* 11), 11459, 11732, 12136A (*par.* 5), 12196, 12239, 12324, 13148, 13288A (*pars.* 5 and 6), 13411, 13482, 13485, 13577, 14182A (*par.* 5), 14218, 14231, 14393, 14434, 14894A (*par.* 1), 14906, 15047, 15277, 16883 (*par.* 1), 16900, 16926, 17077, 17084, 19095A (*par.* 7), 19135.
Amount of water required, 18593, 18828, 18832, 19135, 19586, 19589.
Damage to coal, probability of, views as to, 11837A (*par.* 5), 11884, 12197, 13413, 13580, 15277, 15448A (*par.* 5), 15482, 15937A (*par.* 5), 16883 (*par.* 1), 16900, 16926, 17077, 17084, 17091, 18330, 18485, 18580A (*par.* 3), 18593, 18731, 18735, 19136.
Weight of coal would be affected, 18593.
Depth to which surface of wagons should be watered, 15039.
Discretion to manager as to, preferable to General Rule, 13220, 13222.
Midland district, not practised in, 13700.
Objections on part of workmen improbable, 19592.
Screens, injury to, possible, 13145, 14182A (*par.* 5), 14231, 14393, 18330, 18332, 18484, 19542.
Unnecessary with slow haulage system, 16112A (*par.* 2), 16130.

Wales, witnesses giving evidence as to—Professor Galloway, Mr. Hannah, Mr. Richards, and Mr. Routledge. (*For separate indexes to their evidence, see Index II.*)

Water, Natural, in Mines:
Amount of, in a wet mine, 11497.
Channel in which water is made to flow, 11331A (*par.* 5), 11370, 11763.
Damage done by, 12478, 12528, 12586.
Dust prevention by, 12136A (*par.* 6).
Proportion of moisture in coal in different districts, 14146.
Tables of hygrometer tests, 15171 (*par.* 4).

Watering in Mines:
Ankylostomiasis. danger of, probably increased by, 10546 (*par.* 31), 11000 (*par.* 16), 11270, 18784.
Oil or tar instead of water for these mines, suggestion as to, 14459A (*par.* 13), 14495, 14560.
Westphalian Mines, outbreak in, 11270.
Amount of water required, 13662A (*par.* 10), 13932, 13975.
Binding material, use of, unnecessary, 14578.
Brine, watering with, 13572, 11837A (*par.* 10).
Calcium chloride, solution of. watering with, 18664:
Cost of, 18665, 18792, 18904.
Danger to roof and sides, 18802.
Frequency of, 18667, 18805.
Character of mines and nature of strata in relation to watering, 11790, 13815, 14285, 17917.
Classification of mines as to extent of watering possible, 14459A (*par.* 24).
Compulsory watering or General Rule as to watering, views as to whether desirable, 10410, 10546 (*pars.* 28 and 54), 10611, 10657, 10662, 10830.

Watering in Mines—*cont.*
Compulsory watering, &c.—*cont.*
10873, 10917, 10925, 10939, 11000 (*par* 16), 11170, 11178, 11331A (*pars.* 1 *et seq.* and 6), 11337, 11438, 11628, 11772, 11837A (*par.* 6), 11887, 12099, 12136A (*par.* 6), 12257, 12262, 12315, 12462, 12594, 12640, 12653A (*par.* 6), 12711, 12842, 12862, 12870, 12919A (*par.* 17), 13114, 13118, 13144, 13164, 13343, 13364, 13521, 13530, 13662A (*par.* 8), 13727, 13858, 14182A (*par.* 6), 14325, 14388, 14648, 14894A (*pars.* 2, 3 and 7), 15257, 15540, 15598, 15864. 15869, 15872. 15900, 15927, 15937A (*pars.* 8, 9 and 10), 15953, 16092, 16112A (*par.* 7) 16160, 16256, 16368A (*par.* 2), 16428, 16805, (*par.* 2), 16921, 16942, 17169, 17548 (*par.* 17), 17590, 17892, 18255A (*pars.* 10 and 12), 18315, 18360, 18714, 19298.
Discretion to owners and managers as to, views as to, 11674, 12505, 12864, 12870, 12873, 12919A (*par.* 17), 13947, 14017, 14843, 15035, 15171 (*par.* 12), 15230, 15255, 15293, 15311, 15434, 18450, 18717.
Exemptions would have to be numerous, 10411, 10830, 11170, 11331A (*par.* 6), 12136A (*par.* 6), 13036, 13662A (*par.* 8), 13727, 13858, 15171 (*pars.* 4 and 16), 15256, 15257, 15331, 15448, 15937A (*par.* 8), 16093, 16112A (*par.* 7), 16160, 16256, 16368A (*par.* 2), 16428.
Reluctance, probable, of inspectors to take responsibility of granting exemptions, 15937A (*par.* 8).
Safety lamps, withdrawal of might result from, 15937A (*par.* 9).
Cost of, 10173 (*par.* 23), 10618, 10624, 10640, 10917, 10934, 10937, 11331A (*par.* 2), 11486, 11596, 11837A (*par.* 9), 12136A (*par.* 6), 12257, 12262, 12640, 13048, 13056, 13150, 13396, 13496, 13514, 13516, 13932, 13942, 14018, 14168, 14170, 14894A (*par.* 3), 14954, 15448A (*par.* 6), 15505, 16883 (*par.* 3), 16985, 17239, 18355, 18664, 18792, 18794, 19095A (*pars.* 14, 15, and 16), 19240, 19270, 19408, 19428, 19493, 19510, 19512.
Danger and difficulties of, 10356, 10406, 10546 (*pars.* 28 and 55), 10618, 10877, 11000 (*pars.* 14, 15 and 16), 11126, 11162, 11331A (*par.* 2), 11337, 11485, 11588, 11822, 12064, 12099, 12127, 12866, 14845, 14894A (*par.* 4), 14932, 15864, 15872, 15900, 16112A (*par.* 5), 16147, 17168:
Breakage of pipes by falls of stone, 19319, 19611.
Effect on roof, sides and floor. 10406, 10505, 10508, 10516, 10546 (*par.* 55), 10611, 10878, 10914, 10939, 10944, 11000 (*pars.* 14 and 15), 11164, 11163, 11331A (*pars.* 2 and 3), 11340, 11347, 11354, 11455, 11505, 11790, 11815, 11837A (*par.* 6), 11889, 12033, 12125, 12136A (*par.* 6), 12218, 12223, 12584, 12505, 12653A (*par.* 6), 12711, 12843, 12866, 12919A (*pars.* 9 and 14), 12966, 12971, 13063, 13288A (*par.* 6), 13307, 13322, 13344, 13488, 13497, 13545, 13709, 13725, 13832, 14045, 14053, 14182A (*par.* 6), 14250, 14317, 14894A (*pars.* 2 and 4), 14936, 15028, 15064, 15131, 15156, 15171 (*pars* 4 and 8), 15181, 15188, 15190, 15281, 15347, 15448, 15671, 15685, 15859, 15953, 16011, 16013, 16095, 16112A (*pars.* 5 and 6), 16147, 16153, 16284, 16586, 16632, 16883 (*par.* 4), 16937, 17173, 17245, 17250, 17294A (*par.* 4), 17326, 17394, 17437, 17540, 18255A (*pars.* 3, 5 and 10), 18316, 18337, 18580A (*par.* 5), 18754, 18908, 19095A (*par.* 15), 19249, 19257, 19300, 19403, 19495, 19545, 19553.
Accident in Ferndale Colliery, 19545, 19561.
Creosoted timber, 13030.
Photographs and specimens of stone showing, 15673, 15859.
Pickering, Mr., tests by, 15171 (*par.* 4).
Time at which repairs to roof and sides are made, Ferndale Colliery, 19409.
(*See also title* Accidents, *sub-heading* Falls of Roof and Sides.)
Haulage accidents, possible increase by, 12136A (*par.* 6), 12294, 14182A (*par.* 6), 14253, 14320, 14323, 19095A (*par.* 15), 19260.
Health of horses, possible effect on, 12136A (*par.* 6), 12291, 13545, 13584.

Digitized by Google

Watering in Mines—*cont.*
Danger and difficulties of—*cont.*
Health of miners, probable effect on, 10546 (*pars.* 30 and 31), 11000 (*par.* 16), 11331A (*par.* 4), 11367, 11508, 11818, 11837A (*par.* 9), 11887, 12136A (*par.* 6), 12296, 12300, 12653A (*par.* 6), 13545, 13584, 14894A (*pars.* 2 and 4), 14932, 14990, 15078, 15171 (*par.* 17), 15253, 15874, 15937A (*par.* 11), 16112A (*par.* 12), 16197, 16883 (*par.* 4), 16953, 17174, 17251, 17259, 17534, 18580A (*par.* 6), 18600, 18608, 18770, 18780, 18886.
Ankylostomiasis, *see that title.*
Wages, increase demanded on account of, 12136A (*par.* 6), 12298.
Increase of dust by intermittent watering, possibility of, 11000 (*par.* 14).
Spontaneous combustion, danger of, 13662A (*par.* 17), 13792, 14172, 14182A (*par.* 5), 14231, 14395, 14456, 15937A (*par.* 12), 15959.
Strata, nature of, in relation to, 11790, 13815, 14285.
Timbering and steel girders, probable effect on, 10413, 11000 (*par.* 15), 11288, 13715, 13836, 14046, 14147, 14158, 14420, 16112A (*par.* 6), 16157, 16298, 17294A (*par.* 4).
Beneficial effect, views as to, 13571, 13575, 13608.
Cost of timbering in wet and dry mines compared, 14048.
Creosoted timber unsatisfactory, 13030, 13037.
Substitution of steel girders for timber, views as to, 13718.
Ventilation, possible effect on, 19405.
Warwickshire mines especially unsuitable, 11167.
Decision as to watering should rest with managers, 12505, 12919A (*par.* 16), 13013, 13143.
(*See also title* Zones, *sub-heading* Discretion.
Extent of, and views as to extent desirable, 10173 (*pars.* 24, 25, 26 and 27), 10202, 10204, 10208, 10210, 10404, 10483, 10493, 10496, 10526, 10612, 10617, 10635, 10734, 11809, 11815, 11837A (*par.* 6), 11887, 12228, 12230, 12240, 12320, 12653A (*par.* 6), 12919A (*par.* 15), 12983, 12985, 12988, 12992, 12993, 12997, 12999, 13013, 13047, 13063, 13288A (*par.* 6), 13343, 13439, 13479, 13488, 13576, 13707, 13727, 13858, 14182A (*par.* 6), 14246, 14459A (*par.* 26), 14524, 14533, 14540, 14894A (*par.* 2), 14957, 15187, 15448A (*par.* 6), 15492, 15497, 15558, 15686, 15937A (*par.* 9), 15991, 15993, 16104, 16112A (*par.* 8), 16150, 16191, 16586, 16588, 16630, 16883 (*par.* 2), 16919, 16921, 16928, 16937, 17003, 17209, 17326, 17395, 17615, 17930, 18255A (*par.* 11), 18339, 18378, 18580A (*par.* 5), 18597, 18656, 19095A (*par.* 15), 19197, 19222, 19538.
Inspectors of mines, evidence of, as to, 12320.
Thorough watering, views as to, 10613, 10635, 12707, 12711, 13288A (*par.* 6), 13343, 13442, 13479, 13488, 13576, 13663A (*par.* 8), 13707, 13727, 13858, 14182A (*par.* 6), 14894A (*pars.* 2 and 4), 14931, 15448A (*par.* 6), 15502, 15540, 15545, 15581, 15598, 16112A (*par.* 5), 16147, 16284, 16883 (*par.* 2), 16919, 16921, 16928, 16937, 17003, 17209, 17326, 19095A (*par.* 15), 19222.
Cost of, estimate of, 10618, 10624, 10741, 10917, 10925.
Zones, *see that title.*
Face, watering at, views as to, 10546 (*pars.* 28 and 31), 10581, 10585, 10759, 11004, 11272, 13638, 19191.
South Wales, mines in, practice as to, 19191.
Frequency of, views as to, 13707, 14459A (*par.* 25), 14894A (*par.* 2), 15448A (*par.* 6), 15499, 16112A (*par.* 6), 16883 (*par.* 2), 16939, 17294A (*par.* 4), 17329, 18764.
Germany, watering in, *see title* Germany.
Glamorganshire mines, return as to, 19201 and Appendix II. *page* 296.
Hose and stand-pipe system, 10173 (*pars.* 21, 22 and 23), 10196, 10400, 10546 (*para.* 66 and 68), 10671, 10673, 12919A (*par.* 12), 12983, 13047, 13048, 13243, 13478, 14459A (*par.* 25), 15171 (*par.* 8), 16883 (*par.* 2), 16919, 16926, 16985, 16999, 19095, 19095A (*para.* 10, 12 and 14), 19205, 19319.
Cost of, 10173 (*par.* 23), 16985.
Watering in Mines—*cont.*
Hose and stand-pipe system—*cont.*
Inspection of pipes, 19326.
Length of roadways watered, Ferndale Collieries, 19095A (*par.* 16), 19267.
Extent unwatered, 19288, 19293, 19315.
Plans showing all water pipes on main haulage roads, Ferndale Collieries, 19312.
Size of pipes, 19316.
Inclination, heavy, effect on watering, 13562.
Jets of water with compressed air, 10546 (*par.* 65), 10668, 10737.
Attitude of workmen as to, 10670.
Sketch of a jet, 10668.
Local conditions, consideration of, importance of, 15171 (*par.* 16).
Monmouthshire, *see that title.*
Qualifications desirable in man having charge of watering, 10536, 10673.
Report on, by Dr. Haldane and others, 16112A (*par.* 8), 17231.
Return as to watering in Glamorganshire mines, 19201, and Appendix II., *page* 296.
Scotland, *see that title.*
Sanitary purposes, watering for, 13742, 13790, 14643, 14811, 15530, 16106, 17342, 17408.
Shot-firing in relation to, *see title* Shot-firing, *sub-heading* Watering in neighbourhood of a Shot.
Spray system, 10173 (*pars.* 21, 22 and 23) 10195, 10400, 10546 (*par.* 64), 10668, 12136A (*par.* 6), 13288A (*par.* 6), 13489, 14459A (*par.* 26), 14536, 14537, 14622, 14826, 14834, 14894A (*par.* 2), 14957, 15069, 15134, 15171 (*par.* 8), 16883 (*par.* 2), 16919, 16926, 16999, 18339, 18378, 18600, 19095A (*par.* 10), 19203, 19219.
Attitude of miners as to, 10401.
Cost of, 10173 (*par.* 23), 16985.
Intake, sprays in, 15171 (*par.* 8), 15195.
Superseded largely by stand-pipe and hose, in South Wales, 10173 (*par.* 22), 10400, 19205.
(*See also sub-heading* Tanks, Trams, or Water Barrels—Spray and Tank system.)
Standard of dryness or wetness, suggestion as to, 11331A (*par.* 7), 11432, 11451.
Syringe or shoot of water for roof, suggestion as to, 14957.
Tanks, trams, or water-barrels, use of, 10173 (*par.* 25), 10972, 12723, 14459A (*pars.* 25 and 26), 14835.
Cask and tank system, 19095A (*par.* 10), 19210.
Cost of tank and hose system, 16112A (*par.* 11), 16190.
Spray and tank system, 12919A (*par.* 9), 12965, 13662A (*par.* 9), 13788, 13910, 15448A (*par.* 6), 15564, 18339, 18378.
Amount of water required, 13662A (*par.* 10), 13933, 13976.
Arrest of explosion by, views as to whether probable, 13911, 13915, 13917, 14041.
Cost of, 13987, 14170.
Plate showing apparatus in use at Blackwell Collieries, 13913.
Time of watering, 13983.
Temperature of mines, effect of, on, 13584, 17533, 18886.
Wagons, watering coal in, *see title* Wagons.
Westphalian Mines, *see title* Watering in Germany.
Zones, *see that title.*

Westphalian Mines, *see title* Germany.

Wingate Colliery Explosion:
Account, general, of, 16501 *et seq.*
After-damp, 17126, 17131, 17358, 17390, 17523.
Arrest of explosion, 16516, 16533, 16747, 17111, 17119, 17202, 17389.
Cause of (shot-firing), 14506, 15962, 15999, 16002, 16007, 16501, 16504, 16558, 16565, 16629, 16638, 16718, 16721, 16772, 16835, 16838, 16841, 17140, 17282, 17318, 17519.
Detonator and explosive carried by same man, 17636, 17639.
Explosive used, 16504, 16561, 16583.
License held by man firing shot, 16721.
Plan showing placing of shot, 16565.
Watering in neighbourhood of the shot omitted on this occasion, 16643.
Coroners' Inquest, 16869, 16928.
Course traversed by, 16503, 16519, 16563, 16747, 16752, 17101, 17127, 17200.
Zone, apparently damp and dustless, traversed by, 16508, 16537, 16542, 16556, 16747, 16754, 16760, 16822, 17103, 17200, 17203, 17348.

Digitized by Google

Wingate Colliery Explosion—*cont.*
Dust, 16029, 16566, 16763, 17056, 17432.
Face, safety of, exemplified by, 14498.
Gas, absence of, 14746, 16802, 16865.
Plan, 16499, 16565.
Reports on, 16499, 16506, 16569, 16576, 16582, 16630, 16648, 16651, 16743, 16747, 16763, 16833, 16869, 16873.
Rescue apparatus, views as to whether good use might have been made of, 17236, 17358.
Safety lamps:
Caution board as to, 16837.
Extent to which lights used, 16838, 16840.
Zones, dustless, position in which they might have been placed, 17066, 17071.

Women and Children working in mines: legislation prohibiting, 14429,

Wood Pit Explosion, Haydock, returns traversed by, 15109.

Woolwich, experiments' gallery at, 10872, 10968, 10994.

Yorkshire: Witnesses giving evidence as to—Mr. Chambers, Mr. Garforth, Mr. Habershon, Mr. Nevin, Mr. Rhodes. (*For separate Indexes to their evidence, see Index II.*)

Ystrad Explosion, absence of men from pit during, 19558.

Zones, System of:
Advantages of dry and wet zones compared, 11023, 11115, 11331A (*par.* 9), 12031, 12252, 12327, 13376, 13395, 13459, 13507, 13730, 13743, 13909, 14030, 14136, 14455, 14554, 14676, 15252, 15273, 16112A (*pars.* 9 and 14), 16167, 16169, 16256, 17659, 17897, 18255A (*par.* 12), 18503, 19256.
Afterdamp, effect on, 10648, 11259, 11680, 12002, 13023, 13992, 15937A (*par.* 10).
Arching, 10173 (*par.* 36), 10219, 10222, 10227, 10455, 10546 (*par.* 60), 10643, 10661, 10841, 10886, 10890, 11627, 11837A (*par.* 8), 11898, 11902, 11950, 12061, 12128, 12136A (*pars.* 6 and 7), 12249, 12302, 12470, 12534, 12535, 12546, 12570, 12653A (*par.* 7A), 12730, 12771, 12772, 13033, 13121, 13124, 13288A (*par* 6), 13309, 13322, 13331, 13348, 13356, 13423, 13456, 13499, 13533, 13635, 13638, 13662A (*par.* 8), 13726, 13728, 13897, 14182A (*par.* 6), 14257, 14355, 14456, 14681, 14894A (*par.* 2), 14963, 15032, 15171 (*par.* 16), 15294, 15448, 15448A (*par.* 6), 15866, 16097, 16112A (*pars.* 8 and 10), 16162, 16182, 16275, 16300, 16817, 16883 (*pars.* 2 and 5), 16930, 16943, 17185, 17271, 17277, 17294A (*par.* 13), 17536, 17548 (*par.* 22), 17657, 17659, 17894, 18580A (*par.* 7), 18605, 19095A (*par.* 11), 19220.
Barrel arch, 12653A (*par.* 7), 12730, 12771, 12848.
Cost, 15171 [*par.* 4), 15448A (*par.* 6), 15515.
Depth at which arching would probably be impracticable, 13124, 13425.
Pillars of coal to support arch, views as to, 12628, 12775, 12910, 12914, 13331, 13499, 13635. 16275.
Plates illustrating, 11048, 11902, 12133.
Possibility of procuring dry, dustless zone without arching, views as to, 14287, 16817, 16931.
Steel or iron props or girders, 10843, 11000 (*par.* 8), 11048, 11055, 12544, 13033, 13121, 13535, 13718, 15030, 15171 (*par.* 4), 15188, 18605.
Cementing or otherwise smoothing sides, views as to, 10546 (*par.* 60), 11000 (*par.* 7), 11024, 11048, 11055, 11187, 12653A (*par.* 7), 12734, 14289, 14456, 15956, 16300, 16883 [*par.* 5], 16943, 18580A (*par.* 7). 18605.
Plate illustrating, 11048.
Cost of, 11018, 11040, 11116, 11158, 15171 (*par* 4), 15448A (*par.* 6) 15510.
(*See also sub-heading* Watered Zones, Cost of).
Discretion to management as to, views as to, 11674, 12505, 12864, 12870, 12873, 12919A (*par.* 17), 13179, 13248. 13746, 13947. 14843, 15035, 15171 (*par.* 12) ,15255, 15293, 15311, 15434, 18450, 18717.
Disputes as to, settlement of, 14017.
Dry dustless zones, 10459, 11000 (*par.* 6 *et seq.*), 11018, 11023, 11025, 11047. 11054, 11187, 11241, 11331A (*par.* 9), 11369, 11376, 11511, 11576, 11627, 11725, 12939, 13662A (*par.* 16), 13739, 13897, 14030, 14182A (*par.* 6), 14389, 14459A (*par.* 32), 14813, 15252, 15259, 15876, 16162, 16256, 17162, 17182, 17245, 17548 (*par.* 22), 18580A (*par.* 7).

Zones, System of—*cont.*
Dry, dustless zones, suggestions as to—*cont.*
Absolute freedom from dust, impossibility. of securing, views as to, 12919A (*pars.* 6, 7 and 8), 12939, 12946, 13042, 13108, 13156, 13161, 13392, 13507, 13662A (*pars.* 8 and 10), 13739, 13860, 13897, 13949, 14557, 14561, 14819, 15877, 16592, 16931, 16615, 16623.
Advantages of dry and wet zones compared, *see sub-heading* Advantages.
Arching, *see that sub-heading.*
Arrest of explosion by, views as to, 11020, 11058, 11059, 11062, 11231, 11424, 11457, 11902, 12031. 12120, 12252, 12941, 13112, 13376, 13731, 13737A, 13740, 13855, 14030, 14128, 14136, 14359, 14554, 14822, 15129, 15252, 15274, 15433, 16168, 16175, 17065, 17097.
Blackwell Colliery Explosion, *see that title.*
Elemore explosion, failure to arrest, 13732, 13737A, 14128, 14129.
Wingate explosion, failure to arrest, *see title* Wingate Explosion, *sub-heading* Course of.
Babbington Colliery, practice as to, in, 11000 (*par.* 17), 11038, 11050, 11058, 11076, 11231.
Cost of. 11040.
Extent of sweeping, 11068.
Plans. 11048, 11173.
Roof and sides. treatment of, 11048.
Cementing or otherwise smoothing sides, *see sub-heading* Cementing.
Compressed air, jets of, 10546 (*par.* 65), 10668, 10683, 10852, 11025, 11039, 15029, 17616.
Compulsory provision of Zones, views as to whether desirable, 12053, 16806, 17440, 18449, 18718.
Cost of, 11040, 11081, 12029, 12449.
Danger of carrying fine dust near face, 12919A (*par.* 8), 12940, 12950, 13103.
Discretion to managers as to wet or dry zones, *see sub-heading* Discretion.
Experiments, suggestions as to, *see sub-heading* Experiments.
Fiery and non-fiery mines, distinction between, views as to, 13891, 14297.
Frequency with which roads must be swept, 11035, 11068, 11081, 11119, 11667. 11727, 11736, 11741, 11946, 12437, 12780, 12783, 13662A (*par.* 10), 13739.
Length of zones, views as to, 11022, 11023, 11234, 11425, 11676, 11905, 12254, 13377, 13662A (*par.* 16), 13731, 13737A, 14259, 14561, 14822, 16822, 16883 (*par.* 2), 17197, 17548 (*par.* 22), 17732.
Number of zones in a mine, views as to, 13944.
Object, special, of, 13992.
Paving, *see that sub-heading.*
Position of zones, 12653A (*par.* 7), 13868, 13891, 14002, 14004, 14013, 14276, 15634, 15899, 16883 (*pars.* 2 and 5), 17271, 17536, 18718.
Report by Dr. Haldane on Westphalian mines, suggestion as to zones contained in, 17231.
Shape of zones, suggestions as to, 14950.
Shot-firing, prohibition in mines in which dustless zones are impracticable, views as to, 13431.
Watered zones, *see title* Watering.
Watering allied with brushing away, 11028, 11381, 11894, 12243, 12653A (*pars.* 6 and 7), 12712, 12729, 12780, 12783, 12787, 12860, 12954, 13421, 14894A (*par.* 5), 14947, 14963, 15200, 15274, 16112A (*par.* 8), 16170, 16819, 16928, 16958.

Experiments as to, advocated, 11430, 11457, 12949, 13182, 13380, 13738, 13861, 13880, 13903, 14136, 14948, 14950, 14989, 14993, 14996, 15252, 15275, 15433, 15696, 15904, 15937A (*pars* 10 and 11), 16259, 16587, 16820, 17197, 17548 (*par.* 22), 17732, 18456.

Paving roadways, 10546 (*par.* 60), 11000 (*par.* 6), 11018, 11023, 11025, 11047, 11056, 11115, 12136A (*par.* 6), 12256, 12534, 12653A (*par.* 7), 12571, 14894A (*par.* 2), 16944, 19095A (*par.* 15), 19257.
Cost of, 11018, 11040, 11116, 11158, 15448A (*par.* 6), 15515.
Sketches of roadways so treated, 11048.

Digitized by Google

Zones, System of—*cont.*
Watered zones, 10173 (*pars.* 28, 33, 36 and 42), 10222, 10227, 10354, 10546 (*pars.* 18, 33 and 58), 10614, 10638, 10873, 10972, 11331A (*par.* 8), 11454, 12136A (*pars.* 6 and 7), 12499, 12534, 12544, 12550, 12594, 12596, 12638, 12653A (*pars.* 6 and 7), 12721, 12919A (*par.* 17), 13120, 13288A (*par.* 6), 13342, 13348, 13529, 13538, 13662A (*par.* 16), 13744, 13932, 13975, 14389, 14459A (*par.* 27), 14838, 14894A (*par.* 2), 14989, 15171, (*par.* 16), 15251, 15270, 15448A (*par.* 6), 15955, 16095, 16368A (*par.* 2), 16633, 16883 (*pars.* 2 and 5), 17097, 17162, 17172, 17548 (*par.* 22), 17913, 19095A (*par.* 11).
Advantages of wet and dry zones compared, *see sub-heading* Advantages.
Arrest of explosion by, views as to probability of, instances of arrest, &c., 10173 (*pars.* 26 *et seq.*), 10204, 10208, 10210, 10546, (*par.* 18), 10560, 10574, 10646, 12230, 12919A (*par.* 17), 13020, 13181, 13288A (*par.* 6), 13301, 13342, 13348, 13354, 13504, 14459A (*pars.* 11 and 13), 14491, 14598, 14894A (*par.* 2), 14946, 15171 (*par.* 16), 15433, 15448A (*par.* 6), 15502, 15545, 15581, 15598, 15637, 15645, 15656, 15660, 15906, 16883 (*par.* 2), 17097, 17294A (*par.* 12), 17347, 17387, 17401, 17410, 18346, 18368, 18654.
Failure to arrest, apparent instances of, 10493, 10496, 10526, 13300, 13302, 13347, 13353, 13378.
(*See also title* Wingate Colliery Explosion, *sub-heading* Course Traversed.)
Arching, *see that sub-heading.*
Brine, experiment with, 10980, 10987.
Brushing away and watering combined, 11028, 11381, 11894, 12243, 12653A (*pars.* 6 and 7), 12712, 12729, 12780, 12783, 12787, 12788, 12860, 12954, 13421, 14894A (*par.* 5), 14947, 14963, 15200, 15274, 16112A (*par.* 8), 16170, 16819, 16928, 16958.
Cementing or otherwise smoothing sides, *see sub-heading* Cementing.
Compulsory provision, views as to, 10657, 10662, 10831, 10857, 13178, 13249, 13443, 13538, 13662A (*par.* 8), 14990, 15870, 15927, 16256, 16428, 16806, 17440, 18718, 19298.
Cost of, estimates of, 10640, 10934, 11780, 12266, 12276, 12283, 13048, 13243, 13396, 13514, 13516, 14018, 14170, 14894A (*par.* 3), 14954, 15448A (*par.* 6), 15507, 15515, 16112A (*par.* 9), 19243.
Calcium chloride solution, cost with, 18664, 18792, 18794.
Experiments, suggestions as to, *see sub-heading* Experiments.
Face, zone watering at, views as to, 10759.
Frequency with which zones should be watered, 10974, 13746, 13982, 14642.
Length of zones, views as to, 10173 (*par.* 33), 10208, 10213, 10488, 10546 (*pars.* 18, 33 and 61), 10559, 10932, 11331A (*par.* 8), 11423, 11676, 11678, 12136A (*par.* 6), 13069, 13238, 13353, 13536, 13662A (*par.* 16), 13746, 13747, 14554, 14561, 14839, 15097, 15502, 16112A (*par.* 8), 16161, 16587, 17294A (*par.* 12), 17410, 17548 (*par.* 22), 17732, 18344, 18368, 18504, 19095A (*par.* 11).
Experiments as to, advocated, 13182.
Life-saving, probable extent of, 10649.
Number of mines in which zone watering would be practicable, 13526.
Number of zones required, 10225, 13075, 13446, 13748, 15514, 15580.
Object, particular, of zone watering, 13165, 13758, 13794, 13796.
Paving, *see that sub-heading.*
Plan illustrating, 10546 (*par.* 58), 10638.
Position of zones, 10224, 10546 (*par.* 59), 10638, 10975, 12026, 12136A (*par.* 6), 12722, 12873, 13445, 13543, 13550, 13638, 13748, 13795, 15094, 15142, 16162, 17294A (*par.* 12), 19095A (*par.* 11).
Report by Dr. Haldane and others on watering in Westphalian mines, suggestion as to zones contained in, 16112A (*par.* 8), 17231.
Shapes of zones, suggestion as to, 14950.
Shot-firing in relation to, 10225, 13431, 13754, 13756.
Systems of watering, *see title* Watering, *sub-headings* Hose and Pipe System, Spray System, *and* Tanks, Trams, or Water Barrels.
Whitwood Colliery, zones in, 11837A (*par* 6), 11898, 12053:
Cost of, 12029.
Number of, 12029.
Position of, 12029, 12029A.
Sheets to prevent dust travelling into mine, 11837A (*par.* 6), 11896.

Digitized by Google

INDEX II. (The Evidence of each Witness Indexed Separately).

ARMSTRONG, Mr. WILLIAM, Manager of Wingate Grange Colliery Company, Durham. (*See questions* 16495—16882.)

Blantyre Explosion, cause of, 16878.

Committee on Bobbinite : evidence as to amount of explosive used, 16658.

Discipline, lectures to men on, questions as to, 16672.

Dust in Mines :
- Amount of, report on, 16763.
- Danger from :
  - Extent to which appreciated by miners, views as to, 16582, 16694, 16737.
  - Lectures to official shot-firers, danger mentioned in, 16695, 16861.
- Definition of a dry and dusty mine, difficulty of, 16808.
- Explosions, cause of, 16607 :
  - Amount of dust required to carry on an explosion, 16604, 16621.
  - Harmless quantity, experiments as to, advocated, 16814.
  - Small quantity of dust frequently more dangerous than large, 16596, 16606, 16622, 16703, 16740, 16874.
  - Theory inapplicable to collieries in which gas is present, 16708.
- Inflammability of various kinds of dust, 16745.
- Prevention or removal of :
  - Brushing away, extent to which practised in Wingate Colliery, and extent to which dust is removed, 16592, 16615, 16623, 16766.
  - Compulsion as to, views as to, 16743, 16806.
  - Screening plant, dust from, going down downcast shaft : fans for prevention of, views as to, 16791.
  - Systematic prevention, no arrangement for, 16765.
  - Vacuum cleaner, use of, views as to, 16811.
  - Zones (dry, dustless) :
    - Arching, views as to whether necessary, 16817.
    - Compulsory provision, views as to, 16743, 16806.
    - Length of, experiments as to, advocated, 16822.
    - Watering combined with brushing away advocated, 16819.
    - Wingate explosion, failure of dustless zone to arrest, 16508, 16537, 16542, 16556, 16747, 16754, 16760, 16822.

Experiments as to dust, suggestion as to :
- Amount required to cause an explosion, 16611, 16814, 16882.
- Shot-firing : amount of explosive to be used, experiments advocated, 16637.
- Zones, dustless, experiments advocated, 16587, 16820.

Explosions :
- Experience of Witness as to, 16495, 16702.

(*See also titles* Dust, *and* Wingate Explosion, Oaks Colliery Explosion, &c.)

Explosives, Permitted :
- Exclusion of any explosive undesirable, 16826.
- Purchase of, by miners, from owners—Wingate Colliery, 16651.
  - Charge made, 16652, 16667, 16728.
    - Truck Act in relation to, 16668.
  - Objections to purchase by miners from anyone but owners, 16660.
- Term "Permitted Explosive" preferable to "Safety Explosive," 16583, 16727.

ARMSTRONG, Mr.—*cont.*

Oaks Colliery Explosion : gas present as well as dust, 16704, 16705, 16708, 16878.

Rescue Work : Wingate Colliery arrangements, 16677.
- Aid, as to lectures, &c., not given by Durham County Council, 16678.

Seaton Colliery Explosion : greatest violence was against air current, 16749.

Shot-firing :
- Acts, Rules, &c. :
  - Adequacy of, if strictly observed, 16629, 16649, 16688, 16689, 16714, 16720.
    - Additional regulations in mines, where protected zones are impracticable, unnecessary, 16825.
  - Simplification advocated, 16572, 16580.
  - Special Rules, code of, in Wingate Colliery, 16581, 16692, 16780.
    - Experiments under General Rules, 16781.
- Amount of explosive :
  - Geloxite, amount of, 16653.
  - Indication of, in authorisation for firing shot, views as to, 16775.
  - Limitation not advocated, 16654.
  - Responsibility of fireman for, 16728.
- Face, shot-firing at, Wingate Colliery, 16684.
- Notice to manager and permission from him or from under-manager before shot is fired, in Wingate Colliery, 16774.
  - General Rule to this effect, advisability of, 16775, 16779.
- Officials firing shots, instructions to, 16570.
  - Printed copies of rules, supply of, to officials, views as to whether necessary, 16569, 16575.
  - Rules re-read to firemen every three months, 16571, 16796, 16830, 16861.
- Roads, main haulage, shot-firing in :
  - Abolition of, views as to whether desirable, 16686.
  - Wingate Colliery, shot-firing not practised in main haulage roads in, 16683.
- Watering and brushing away in neighbourhood of a shot :
  - Special Rule as to watering, obligation of officials as to, 16698.
  - Wingate Colliery, practice as to, 16644, 16766.
    - Exception on occasion of explosion, 16642.

Wagons, dust-tight iron, type used in Wingate Colliery, 16794.

Watering :
- Compulsory, universal, undesirable, 16805.
- Dangers and difficulties of : effect of, on roof and sides, 16586, 16632.
- Extent of :
  - Roof and sides as well as floor, views as to, 16588.
  - Wingate Colliery, extent to which practised, 16586, 16589, 16630.
- Zones, watered :
  - Advantage of, 16633.
  - Compulsory provision in dry and dusty mines, views as to, 16806.
  - Discretion of manager as to dry or wet zones, 16811.
  - Length required, uncertainty as to, 16587.

Wingate Colliery Explosion :
- Account, general, of, 16501 *et seq.*
- Arrest of explosion, points of, 16516, 16553, 16747.

Digitized by Google

ARMSTRONG, Mr. W.—*cont.*
Wingate Colliery Explosion—*cont.*
Cause of (shot-firing), 16501, 16504, 16558, 16565, 16629, 16638, 16718, 16721, 16772, 16835, 16838, 16841.
Explosive used, 16504, 16561, 16583.
License held by man firing shot, 16721.
Plan showing placing of shot, 16565.
Watering in neighbourhood of the shot omitted on this occasion, 16642.
Coroners' inquest, no specific recommendations made by jury as to future precautions, 16869.
Course traversed by, 16503, 16519, 16563, 16747, 16752.
Zone, damp and dustless, traversed by, 16508, 16537, 16542, 16556, 16747, 16754, 16760, 16822.
Dust, increase towards the pits, 16566.
Gas, absence of, 16802, 16865.
Plan, 16499, 16565.
Reports on, 16499, 16506, 16569, 16576, 16582, 16630, 16648, 16651, 16743, 16747, 16763, 16833, 16869, 16873.
Safety lamps:
Caution board as to, 16837.
Extent to which lights used, 16838, 16840.

Zones, *see title* Dust, *sub-heading* Prevention or Removal, and *title* Watering, *sub-heading* Zones.

BLACKETT, Mr. W., Agent to the Charlaw and Sacriston Collieries, Ltd., Durham. (*Durham Coal-Owners' Association.*) (*See questions* 14459A—14894).

Accidents:
Coroners' inquests, Reports to Home Office, suggestion as to quatifications of official making, 14459A (*par.* 33).
Falls of roof and sides, compulsory introduction of safety lamps might increase number of, 14641, 14667.

Ankylostomiasis, pits subject to, use of oil and tar in suggested, 14459A (*par.* 13), 14495, 14560.

Brancepeth Explosion:
Cause of, 14459A (*par.* 19), 14604, 14613, 14663.
Coroner's inquest, Report to Home Office, unsatisfactory character of, 14459A (*par.* 33).

Coal Mines Regulation Act, 1887:
Amendment of, or new legislation, views as to whether desirable, 14871.
Section 49: General Rules:
General Rule 8, as to safety lamps:
Definition of a fiery mine contained in, 14751.
Strengthening or more clearly defining, views as to whether desirable, 14753.
General Rule 12, as to shot-firing, 14519.
Simplification of Rules, necessity for, 14459A (*par.* 30), 14510, 14515, 14552, 14562A, 14878.
Strict observance of would probably greatly reduce number of accidents, 14459A (*par.* 29), 14505, 14607, 14663, 14865.

Coal Mines Regulation Act, 1896, Clause 5, Sub-section 3, as to shot-firing, 14518.

Deep Mines:
Dust in mines, depth of, 14807.
Watering, difficulty of in, 14845.

Discipline:
Defective, effect of on number of explosions, 14459A (*par.* 21), 14505, 14607, 14663, 14865.
Elementary schools in mining districts, instruction of children as to importance of discipline, 14849, 14887.
Leaders of Miners' Association, advice to men as to advisability of, 14891.
Lectures to men and boys on matters affecting safety in mining, 14857.
Officials, instruction in matters affecting safety in mining, 14858.

Doors, arrest of explosion by, possibility of, 14459A (*par.* 6), 14469, 14478, 14485, 14591.

Dust:
Classification of mines as dusty and non-dusty, possibility of, 14459A (*par.* 23).

BLACKETT, Mr. W.—*cont.*
Dust—*cont.*
Explosions:
Cause of, 14459A (*pars.* 2, 4, 19), 14465, 14486, 14587, 14600, 14798.
Face, inability to penetrate to, 14459A (*pars.* 11 and 14), 14498.
Urpeth Explosion, *see that title.*
Inflammability of various kinds of dust, 14459A (*par.* 15), 14500, 14707.
Absorption of oxygen by dust, theory as to, 14459A (*par.* 17), 14500.
Face, dust at, usually harmless, 14459A (*par.* 15).
Fine dust on haulage roads most inflammable, 14459A (*par.* 16), 14500.
Prevention or removal of:
Durham and Yorkshire mines: arrangement by witness as to, 14459A (*par.* 25), 14809.
Oil or tar, suggestion as to, 14459A (*par.* 13), 14495, 14560.
Screening plant, dust from, 14459A (*par.* 18).
Shield round pit top, boxing in of screens and exhaustion of dust proposed, 14459A (*par.* 28), 14549, 14533.
Sprays at top of downcast shaft, 14533, 14826.
Watering, *see that title.*
Westrumite, use of, 14495.
Zones (dry, dustless) suggestions as to, 14459A (*par.* 32), 14813.
Absolute freedom from dust, possibility of obtaining without watering, views as to, 14557, 14561, 14819.
Advantage of wet as compared with dry zones, 14676.
Arching of brick, views as to, 14681.
Discretion of manager as to dry or wet zones, views as to, 14843.
Length required, 14561, 14822.
Watering dust before brushing it away, 14809.
Sources of enumerated, 14459A (*par.* 18).

Experiments as to dust:
Advisability of, 14503.
Bedson, Dr., experiments by, 14501, 14503, 14713.
Urpeth colliery explosion, dust analysis, 14712.
Witness has made no experiments, 14707.

Explosions:
Cause of, circumstances determining, 14459A (*pars.* 4–10), 14469.
(*See also title* Dust, *sub-heading* Explosions.
Doors, arrest of explosion by, possibility of, 14459A (*par.* 6), 14469, 14478, 14485, 14591.
Face:
Inability of dust explosion to penetrate to, 14459A (*par.* 11).
Safety of in event of explosion, 14459A (*par.* 14), 14498.
Strict observance of rules, probable effect of in reducing number of explosions, 14459A (*par.* 29), 14505, 14663, 14865.
Safety lamps, use of in relation to: number of explosions caused by naked lights, 14630, 14645, 14666.
Training of miners in matters important to safety, suggestions as to, 14499.
Urpeth, *see that title.*
Velocity of preceding current of air, reduction of, effect of on explosions, 14459A (*par.* 12), 14469, 14485.
Wingate, *see that title.*
(*See also title* Dust, *sub-heading* Explosions.)

Explosives:
Ammonite, use of with electric batteries, 14459A (*par.* 25).

Explosives Order:
Permitted explosives, conditions as to use of and as to withdrawal of men, 14703, 14706.
Simplification, necessity for, 14513, 14516, 14882.

Fiery Mines, definition of, 14732.

Lancashire: Special Rule as to safety lamps, conversion into General Rule advocated, 14762.

Northumberland, absence of firedamp in, 14741, 14751.

Qualifications of Witness, 14459A, 14460.

Digitized by Google

BLACKETT, Mr. W.—*cont.*
Rescue Work, explosions in which witness has had experience of, 14460.

Safety Lamps:
Act of Parliament: Coal Mines Regulation Act, 1887, General Rule 8 as to:
Definition of fiery mines contained in, 14751.
Strengthening or clearer definition, views as to whether desirable, 14629, 14632, 14647, 14753, 14876.
Compulsory universal introduction of not advocated:
Accidents from fall of roof and sides would probably be more numerous in event of, 14641, 14667, 14762.
Explosions in relation to:
Dust explosions, inability to cause, 14603.
Number caused by naked lights, 14628, 14666.
Lancashire Special Rule as to, conversion into General Rule advocated, 14762.

Schools, Elementary, in mining districts, instruction of children in matters conducive to safety in mining, advocated, 14459A (*par.* 22), 14849, 14887.

Seaham Colliery Explosion, course taken by, 14479.

Shot-firing:
Abolition of in mines where watered zones are impossible, views as to, 14679, 14840.
Act of Parliament, Orders, &c., regulating:
Number of shots fired simultaneously, regulation as to, 14787.
Simplification of views as to whether desirable, 14517, 14574.
Strict observance would reduce number of explosions, 14459A (*par.* 20).
Barnsley seam, shot-firing not practised in, 14835.
Durham, regulations as to, 14459A (*par.* 25).
Explosions caused by, 14459A (*pars.* 19 and 20), 14594.
(*See also title* Urpeth Explosion.)
Notice to manager and permission from him before shot is fired, suggestion as to, 14459A (*par.* 32), 14553, 14649, 14655, 14774.
Number of shots fired simultaneously:
General Rule as to, 14787.
Limitation of, views as to whether desirable, 14784.
Official firing shot, 14780.
Conditions, present, as to firing by licensed shot-firer, 14650.
Stemming with coal dust, danger of, 14858A.
Unramming a shot, Durham Special Rule as to, 14796.
Watering in neighbourhood of a shot:
Act of Parliament regulating (Coal Mines Regulation Act, 1887), distinction in between naturally and artificially wet mine, 14690.
Withdrawal of men, regulation as to, in Explosives Order, 14704.

Special Rules:
Discussion as to between men or men's representative and owners, views as to whether desirable, 14890.
Simplification and reduction in number of, necessity for, 14459A (*par.* 30), 14510, 14552, 14562A, 14878.
Strict observance of would prevent many accidents, 14459A (*par.* 29), 14505, 14663, 14865.

Timbering, Special Rules, unsatisfactory working of: number of accidents not reduced, 14564.

Urpeth Explosion:
Arrest of by wet zone, 14459A (*par.* 11), 14491, 14598.
Length of zone, 14824.
Cause of, 14506, 14594, 14785.
Dust analysis, 14712.
Face not penetrated, 14459A (*par.* 11).
Uncertainty as to Shot-firing Orders and regulations exemplified in, 14517.

Ventilation:
Explosions from, 14459A (*pars.* 19 and 20).
Firedamp impossible in some Durham mines, 14646, 14735.

Wagons, dust from, 14459A (*par.* 18).

BLACKETT, Mr. W.—*cont.*
Watering:
Ankylostomiasis, mines subject to, substitution of oil or tar for watering in, suggestion as to, 14459A (*par.* 13), 14495, 14560.
Binding material, use of unnecessary; dust will remain a compact mass for some time after water has evaporated, 14578.
Classification of mines according to extent of watering possible, 14459A (*par.* 24).
Compulsory watering of dry and dusty mines, views as to, 14325, 14648.
Deep mines, difficulty of watering, 14845.
Durham mines, methods employed, 14459A (*par.* 25), 14528.
Extent necessary, 14524, 14540.
(*See also sub-heading,* Zones.)
Sanitary purposes, watering for, 14643, 14811.
Shale or fireclays, effect on, 14459A (*par.* 27).
Shot-firing, abolition advocated in mines where watering is impossible, 14840.
Spray system, 14459A (*par.* 26), 14536, 14537, 14622, 14826, 14834.
Wagons, watering by, 14459A (*pars.* 25 and 26), 14835.
Zones, suggestions as to, 14459A (*par.* 27), 14838.
Advantages of wet as compared with dry zones, 14554, 14676.
Arrest of explosion by, instance of, 14459A (*par.* 11), 14491, 14598.
Frequency with which watering would be necessary, 14642.
Length required, 14554, 14839.
Dry and wet zones, comparison as to, 14554, 14561.

Westrumite, use of for dust prevention, views as to, 14495.

Wingate Explosion:
Cause of, 14506.
Face, safety of, exemplified by, 14498.
Gas had never been seen or heard of in mine previously to, 14746.

Yorkshire:
Depth of mines worked by Witness, 14807.
Dust, precautions as to taken in, 14459A (*par.* 26).
Watering, extent of, 14459A (*par.* 26), 14525, 14533.

Zones, *see title* Dust, *sub-heading* Prevention or Removal, and *title* Watering, *sub-heading* Zones.

BRAGGE, Mr. GEORGE STEPHENSON, Manager of the Granville Colliery, Swadlincote, Burton-on-Trent, and Past President of the National Association of Colliery Managers. (*See questions* 12653A—12919).

Ankylostomiasis: Case suspected, proved not to be the disease, 12753.

Barriers or Boundaries of Coal:
Between collieries and under railways, 12891, 12897.
Width of, 12899.
(*See also title* Pillars.)

Courrières Explosion, similar accident impossible in South Midland District owing to absence of extensive underground intercommunication, 12682.

Deep Mines, arching of brick in, difficulty as to, 12771.
Pillars of coal to support arch, question as to practicability of, 12775, 12910, 12914.

Dust in Mines:
Classification of mines as dusty and non-dusty, difficulty of, 12653A (*par.* 1).
Explosions, cause of, 12653A (*par.* 2), 12694.
Timsbury explosion and explosions in flour mills and maltings proving explosiveness of fine dust under certain conditions, 12653A (*par.* 2), 12678.
Face, dust in, small amount and comparatively harmless character of, 12653A (*par.* 3), 12695.
Inflammability of various kinds of coal dust, views as to, 12653A (*par.* 2), 12661, 12679, 12702, 12714, 12728, 12750, 12662, 12756, 12858.
Samples showing difference in character of dust, 12661, 12850.

Digitized by Google

BRAGGE, Mr. G. S.—*cont.*
Dust in Mines—*cont.*
Prevention or removal:
Mixing dust with non-inflammable dust or other material, views as to, 12653A (*par.* 7 *c*), 12752, 12764.
Salt, mixing with, views as to, 12653A (*par.* 7 *b*), 12751.
Screening plant, removal, objections to, unless proved to be chief source of dust, 12653A (*par.* 5 *d*), 12708.
Zones, dustless, views as to:
Absolute cleansing from dust, impossibility of, 12847.
Arching of brick, and mortared and smooth sides, 12653A (*par.* 7 *a*), 12730, 734 12772, 12848.
Pillars or barriers of coal to support arching, views as to, 12775, 12910.
Brushing away combined with watering, suggestions as to, 12653A (*par.* 6 ii.), 12712, 12729, 12860.
Extent of, 12785.
Frequency of, 12780, 12783.
Position of zones, elasticity as to, advocated, 12653A (*par.* 7).
Roadways, amount and dangerous character of dust in, 12695, 12756.
Sources of, 12653A (*pars.* 3 and 4), 12793.

Experiments:
Dust, experiments as to, advocated, 12653A (*par.* 1), 12659, 12767.
Shot-firing, experiments as to, advocated, 12659, 12670.

Explosions:
Cause of, 12719.
Granville Colliery, explosions in, 12734, 12745.
Number of, and absence of large explosions, 12679, 12738, 12745.

Explosives:
Bobbinite, use of, 12816.

Pillars of Coal:
At bottom of shaft, 12774.
Dustless zones, pillars or barriers of coal to support arching, views as to, 12775, 12910.

Qualifications of Witness, 12654.

Safety Lamps, use of, 12734, 12748.

Shot-firing:
Acts, Orders, Regulations, &c., 12653A (*par.* 6), 12808, 12819, 12830.
Between shifts, instance of, in haulage road, 12821, 12828.
Dangers of certain detonations, theory as to, 12653A (*par.* 2), 12671, 12694.
Electric firing, instance of, 12815.
Experiments as to, advocated, 12659, 12670.
Face, shot-firing during shift in:
Danger, chief, to be guarded against, 12801.
Instance of, 12799.
Notice to and permission from manager, views as to, 12832.
Official having charge of, in haulage roads, 12825, 12833.
Position of shot, importance of, danger of boring in the solid, &c., 12881.
Stemming and drilling, importance of, 12803, 12818, 12880.
Watering in neighbourhood of a shot, Special Rule as to (Midland District), 12653A (*par.* 6).

Spontaneous Combustion, South Midland district subject to, 12694.

Timsbury Explosion:
Fine dust, explosiveness of, proved by, 12653A (*par.* 2), 12678.

Underground Communications, Midland District, 12682

Ventilation, adequacy of, 12749.

Wagons, dust from, 12653A (*par.* 4 B), 12797.
Types of wagons, 12703.
Watering coal in, views as to, 12653A (*par.* 5).

Watering in Mines:
Watering coal in, views as to, 12653A (*par.* 5).

BRAGGE, Mr. G. S.—*cont.*
Watering in Mines—*cont.*
Compulsory universal watering, objections to, 12653A (*par.* 6), 12711, 12842, 12862.
Discretion of manager as to zone watering advocated, in event of compulsion as to watering, 12864, 12870, 12873.
Dangers and difficulties of, 12866.
Effect on roof, floor and sides, 12653A (*par.* 6), 12711, 12843, 12866.
Health of miners, probable effect on, 12653A (*par.* 6 ii.).
Extent of watering that would be required to destroy all dust, 12653A (*par.* 6 i.).
Zone watering, suggestion as to, 12653A (*pars.* 6 and 7), 12721.
Brushing away and watering combined, 12653A (*pars.* 6 and 7), 12729, 12780, 12783, 12785, 12788, 12860.
Discretion of manager as to, advocated, 12864, 12870, 12873.
Paving unnecessary if floor would stand watering without heaving, 12653A (*par* 7 *a*).
Position of zones, 12722, 12873.

Westphalian Mines, watering in, Witness knows nothing of system or its results, 12653A (*par.* 8).

Zones, *see title* Dust, *sub-heading* Prevention, and *title* Watering, *sub-heading* Zones.

BRAIN, Mr. FRANK, Managing Director of the Trafalgar Colliery, Forest of Dean (*Forest of Dean Coal Owners' Association.*) (*See questions* 16368A—16494.)

Coal Mines Regulation Act, Sec. 23, as to examination for manager's certificate of competency, 16461.

Courrières Colliery Explosion, dust analysis, 16426.

Dust in Mines:
Face, dust at, 16440.
Inflammability of various kinds of dust:
Non-inflammable character of dust in Forest of Dean, 16368A (*par.* 2 and 3), 16394, 16399, 16421, 16431.
Report by Mr. Hall to Royal Commission on Coal Dust, 16368A (*par.* 2), 16431.
Instruction of men in dangers of dust, 16392.
Prevention or removal:
Absence of any general system of, in the Forest of Dean, 16435.
Compulsory prevention or removal, exemption of Forest of Dean and similar districts from, in event of, advocated, 16395, 16398.
Roads, haulage, dust is chiefly in, 16441.
Screening plant, dust from, 16442.

Experiments as to dust:
Hall, Mr., experiments by, as to inflammability of various coal dusts, 16368A (*par.* 2), 16395, 16431.
Official tests of dust, arrangement for, advocated, 16368A (*par.* 3).

Explosions: experience of Witness as to, none in Forest of Dean, 16394, 16460.

Explosives:
Detonation, imperfect, 16446.
Engine planes, use of safety explosives in, 16413, 16417, 16438.
Gunpowder, 16394, 16408.

Manager's Certificate of Competency, Examination for, reforms suggested, 16368A (*par.* 1), 16375.
Central Board, 16368A (*par.* 1), 16376, 16389, 16466, 16489.
Classes, both first and second, suggestions of Witness apply to, 16488.
District Boards, reduction in number of, advocated, 16368A (*par.* 1), 16375, 16468.
Home Office, power of, to reduce number of Boards, without alteration of the law, 16461.
Marks, question whether to be fixed by Committee in London or by District Boards, 16475, 16479.
Number of examinations yearly, 16470.
South Kensington examination system, 16381, 16464.

Digitized by Google

BRAIN, Mr. F.—*cont.*
Manager's Certificate of Competency, &c.—*cont.*
Uniformity of questions, 16368A (*par.* 1), 16380, 16462, 16479, 16486, 16489.
Viva voce local examinations, 16368A (*par.* 1), 16380, 16479, 16482.
Qualifications of Witness, 16368A, 16369.
Royal Commission on Coal Dust in Mines, comments on inflammability of various kinds of coal dust, 16368A (*par.* 2).
Hall, Mr., report of, 16431.
Shot-firing:
Acts, Rules, Orders, &c., regulating:
Consolidation advocated, 16409.
Observance of, fairly satisfactory, 16407.
Special Rules unnecessary in Forest of Dean, 16408, 16411.
Face, shot-firing at, 16438, 16455.
Miss-fire shots:
Detonators, search for, advocated, 16405.
Electric fuses, miss-fire shots with, explosion subsequently, 16404, 16446, 16491.
Period to elapse before firing a second shot, 16449, 16454.
Prohibition of men from going near miss-fire shot for some time advocated, 16404, 16454.
Person firing shot, 16455, 16456.
Authority for, 16457, 16493.
Instructions to, 16458.
Watering in neighbourhood of a shot, 16413.
Watering:
Compulsory universal, objections to, 16368A (*par.* 2).
Zones, watered;
Advantages of, 16368A (*par.* 2).
Compulsion, with system of exemptions, advocated, 16428.

BRAMALL, Mr. HENRY, Managing Director of Messrs. Andrew Knowles & Sons, Ltd., Manchester. (*See questions* 18580A—18914.)
Ankylostomiasis, Watering of mines in relation to, 18784.
Clifton Hall Colliery, Explosion at, 18710, 18725.
Coal Mines Regulation Act: Shot-firing regulations under, codification advocated, 18683.
Deep Mines:
Arching, difficulty of maintenance, 18580A (*par.* 7).
Knowles & Co.'s Collieries, depth of, 18580A, 18643, 18851.
Temperature of, 18600, 18608, 18617.
Watering, difficulty and danger of, 18580A (*pars.* 5 and 6), 18600, 18608.
Dust in Mines:
Experiments as to, *see title* Experiments.
Explosions:
Cause of—instance of explosion without gas, 18710, 18726.
Gunpowder, instance of explosion caused by, when permitted explosive failed to cause explosion, 18712.
Witness has had no experience of, 18652.
Inflammability of various kinds of coal dust, 18580A (*par.* 7), 18654, 18663, 18704, 18780.
Prevention or removal of:
Arching, 18580A (*par.* 7), 18605:
Sides built with shale or metal extracted from roof, and top covered with steel girders, suggestions as to, 18605.
Mixing of shale dust or ash with coal dust, 18580A (*par.* 7), 18654, 18704.
Zones (dry, dustless):
Arching, views as to, 18580A (*par.* 7), 18605.
Compulsory provision, with discretion to management as to wet or dry zones, views as to, 18718.
Position of, possible difference of opinion between managers and inspectors as to, 18718.
Screening-plant, dust from:
Amount of dust going down downcast shaft, small, 18580A (*par.* 4), 18660.
Distance from downcast shaft: fans or removal of screens unnecessary, 18580A (*par.* 4), 18595, 18661.
Explosion at top of screens, 18726.

BRAMALL, Mr. H.—*cont.*
Experiments as to dust:
Hall, Mr., experiments by, 18704.
Inflammability of various kinds of dust, 18654, 18657, 18702.
Prevention of dust, experiments advocated, 18702.
Wagons, watering of coal in, 18593.
Explosions:
Dust, *see that title.*
Witness has had no experience of, 18652, 18723A.
Explosives, supply by owners to men, desirability of, 18626.
Explosives Order: codification, suggestions as to, 18683.
Germany, Watering system in:
Introduction into England inadvisable, 18714.
Temperature of mines, reduction by, 18893.
Haulage in Andrew Knowles & Son's Collieries:
Accidents, rarity of, 18821.
Inclination of roads, 18809.
Mechanical haulage, increased use of, 18855, 18859.
System of, 18819.
(*See also title* Wagons.)
Hours of Work in collieries managed by Witness, 18910.
Lancashire: Special Rules as to Shot-firing:
Comprehensive and stringent character of, 18580A (*par.* 8).
Points in which practice goes beyond rules, 18621.
Notice to manager and inspection and permission from him before shot is fired in main haulage road, practice as to, 18633.
Qualifications of Witness, 18580A (*par.* 1), 18581.
Royal Commission on Coal Dust:
Temperature of air on its course through the pit, diagram showing, 18901.
Shot-firing:
Acts, Orders, Regulations, &c.:
Codification and simplification advocated, 18683, 18694.
Lancashire Special Rules, 18580A (*par.* 8), 18621, 18633.
Strict rules and strict observance advocated, 18722.
Between shifts in main haulage roads, practice as to, in mines managed by Witness, 18580A (*par.* 9).
Blown-out shots, 18685.
Drilling of hole by collier or workmen, 18580A (*par.* 8), 18622.
Instruction to shot-firer not to fire shot unless hole is properly prepared, 18686.
Electricity, shots fired by, 18580A (*par.* 8), 18675.
Explosives only to be handled by shot-firer, 18622.
General Rule to this effect advocated, 18625.
Extent to which practised in mines managed by Witness, 18580A (*par.* 9), 18684.
Miss-fire shots:
Time to elapse before firing another shot: long interval unnecessary if electric fuses are used, 18675.
Notice to manager and permission from him before shots are fired in main haulage road 18580A (*par.* 9), 18633.
Inspection by manager or under-manager, 18634.
General Rule as to, advocated, 18639.
Number of shots fired simultaneously: one shot only advocated in main haulage road, 18679.
Person firing shots:
Appointment of, 18580A (*par.* 8), 18693.
Certificate of competency unnecessary, 18698, 18835.
Instructions to, 18690.
Rules printed on authorisation paper, question whether desirable, 18694.
Single individual carrying explosive and detonator, Witness sees no objection to, 18701.
Watering in neighbourhood of a shot, extension of area unnecessary, 18681.

Digitized by Google

BRAMALL, Mr. H.—*cont.*
Strata, nature of, in Andrew Knowles & Co.'s Collieries, 18745.
Temperature of Mines:
Diagrams showing temperature of air on its course through the pit, 18901.
Effect of, on health of men, 18871, 18910.
Knowles & Co.'s Collieries, 18854, 18863, 18866, 18873, 18910.
Watering, effect of, on, 18886.
Wooden wagons, shrinkage of, in mines of very hot temperature, 18642.
Ventilation in Knowles & Co.'s Collieries:
Air compressors, 18860.
Fan system, 18650, 18862.
Wagons:
Dust from, 18807.
Dust-tight, 18584, 18722.
Iron-bodied, 18580A (*par.* 1).
Cost of wooden and iron wagons compared, 18580A (*par.* 1), 18588.
Danger of, on steep inclines; Witness does not agree with this opinion, 18585.
Plate showing wagons used in Knowles and Co.'s Collieries, 18585.
Repair of, cost of, as compared with wooden ones, 18590.
Temperature of mines does not affect dust-tightness, 18642.
Watering:
Amount of water required, 18593, 18828.
Damage to coal, 18580A (*par.* 3), 18593, 18731.
Character of coal as compared with South Wales coal, 18735.
Spraying, inadequacy of, 18593, 18832.
Weight of coal would be affected by, 18593.
Watering:
Calcium chloride, solution of, watering with, 18664.
Cost of, 18792, 18904.
Danger to roof and sides, 18802.
Frequency with which necessary, 18805.
Compulsory universal, inadvisable, 18714.
Dangers and difficulties of:
Effect on roof and sides, 18580A (*par.* 5), 18754, 18908.
Health of men, effect of on, 18580A (*par.* 6), 18600, 18608, 18770, 18780, 18886.
Extent of:
In mines managed by Witness, 18656.
Damping floor, views as to, 18597.
Frequency with which required, 18764.
Roof and sides as well as floor, 18580A (*par.* 5), 18597.
Spray system, 18600.
Temperature of mines, effect of on, 18886.
Zones, watered:
Arrest of explosions by, views as to, 18654.
Compulsory provision of dustless zones, with discretion to manager as to whether wet or dry zones, views as to, 18718.
Cost of, with calcium chloride solution, 18664, 18792, 18794.

CARNES, Mr. C. S., Mining Agent for Messrs. Bolckow, Vaughan & Company, Ltd., &c., &c. (*See questions* 16883—17294.)
Armstrong, Mr., evidence of, references to, 16933, 17061, 17101, 17103, 17116, 17142, 17145.
Coal Mines Regulations Acts, adequacy of, if regulations were strictly carried out, 17061.
Deep Mines:
Future coal supplies must come largely from, 17177.
Watering, difficulty as to, effect on health of men, 17174.
Dust in Mines:
Explosions, amount required to cause:
Experiments as to, advocated, 17195.
Small amount probably more dangerous than large, Witness does not agree with opinion of Mr. Armstrong as to, 16933.
Prevention or removal of:
Arching of roof, 16883 (*pars.* 2 and 5), 16931, 16943, 17186, 17271, 17277.

CARNES, Mr. C. S.—*cont.*
Dust in Mines—*cont.*
Prevention or removal of—*cont.*
Brushing away, 17245:
Combined with watering of floor, 16928, 16958.
Amount of dust that would be left, 16931.
(*See also sub-heading* Zones.)
Compulsion as to freedom from dust in main haulage roads, views as to, 17156, 17163, 17266.
Discretion of manager as to means to be employed, advocated, 17156.
Salt, sprinkling, views as to, 16883 (*pars.* 2 and 6).
Electric haulage engine, use of salt in neighbourhood of, 16950.
Depth of mines in which effective, 16946.
Screening-plant, dust from:
Closing or boxing in of downcast shaft, views as to, 16883 (*par.* 1), 16916.
Fans, 16883 (*par.* 1), 16910, 16918.
Removal of screens unnecessary, 16883 (*par.* 1).
Steam jets at top of screen, 16883 (*par.* 1), 16911, 16918.
Zones (dry, dustless):
Advantage of, views as to, and as to possible arrest of explosion by, 17065, 17097, 17162, 17182.
Arching, or smoothing of sides and roof, 16883 (*pars.* 2 and 5), 16943.
Length of, views as to, 16883 (*par.* 2):
Experiments required, 17197.
Paving of floor not always practicable, 16944.
Position of zones, views as to, 16883 (*pars.* 2 and 5), 17066, 17070, 17271.
Report by Dr. Haldane and others on German watering system, suggestion as to zones contained in, 17231.
Experiments as to dust, suggestions as to:
Amount required to cause an explosion, 17195.
Zones, dustless, length of, 17197.
Explosions:
Afterdamp, death from, prevention of, questions as to, 17126.
Experience of Witness as to:
No instance of dust explosions in Messrs. Bolckow, Vaughan & Co.'s Collieries, 17054.
Wingate Colliery visited after explosion, 17099, 17139.
Safety in event of: instruction of men in best way of getting to downcast shaft, 17136.
Wingate Colliery Explosion, *see that title.*
Germany, watering system in:
Application to Durham mines not advocated, 16883 (*par.* 2), 16942, 17169.
Report by Dr. Haldane and others on Westphalian system, alternatives suggested in, 17231.
Qualifications of Witness, 16883A.
Rescue Apparatus, could not have been used to advantage in Wingate explosion, 17236.
Safety Lamps, compulsory use of, conditions justifying, views as to, and as to suggestions contained in Dr. Haldane's report on German watering system, 17231.
Shot-firing:
Abolition of:
In engine planes, views as to whether desirable, 16977.
In main haulage roads, views as to, 17225.
Murton Colliery, no shots fired in main haulage roads while Witness was manager, 16982, 17227.
Acts, Orders, regulations, &c.:
Adequacy of, to prevent many explosions if strictly adhered to, 16883 (*par.* 7), 17061, 17219, 17230, 17234.
Suggestions as to additional Rules, 17151, 17279, 17289.
Between shifts: prohibition of shot-firing except between shifts:
Durham mines, impracticable in, 16883 (*par.* 7), 16965, 16974, 17212.

Digitized by Google

CARNES, Mr. C. S.—*cont.*
Shot-firing—*cont.*
Between shifts—*cont.*
Engine roads, prohibition in, General Rule as to, inadvisable, 16976.
No individual man to carry both explosive and means of firing it, suggestion as to, 16883 (*par.* 7), 17279, 17289.
Notice to manager and permission from him or from under-manager before shot is fired in main haulage road, advocated, 16883 (*par.* 7), 17146, 17218, 17290.
Official or man firing shots:
Instructions to, consist only in supply of copy of Act and Rules, 17221.
Printing of Rules on back of authorisation paper advocated, 17223.
Main roads, firing in, by official only advocated, 17290.
Wagons:
Dust from, amount of, 17093.
Dust-tight: types advocated, &c., 16883 (*par.* 1), 16887, 16897, 17086, 17095, 17247.
Repair, importance of, 16887.
Inspection to ascertain conditions as to, views as to whether desirable, 16892.
Type of, 16883 (*par.* 1), 16887, 17086, 17096.
Watering (spraying) coal in, views as to, and as to damage to coal in some mines, 16883 (*par.* 1), 16900, 16926, 17077, 17084, 17091.
Watering:
Advantages of and probable arrest of explosion by, views as to, 16883 (*pars.* 2 and 5), 17097, 17162, 17172, 17243.
Compulsory, universal system as in Germany, application to England, views as to whether desirable, 16883 (*par.* 2), 16921, 16942, 17169.
Cost of, estimate of, based on cost in Bolckow, Vaughan & Co.'s Collieries, 16883 (*par.* 3), 16985, 17239.
During process of getting coal down, unnecessary, 16883 (*par.* 2).
Dangers and difficulties of, 17168.
Effect of on roof, sides and floor, 16883 (*par.* 4), 16937, 17173, 17245, 17250.
Health of miners, possible effect on, 16883 (*par.* 4), 16953, 17174, 17251, 17259.
Extent advocated—thorough watering (roof and sides as well as floor), 16883 (*par.* 2), 16919, 16921, 16928, 16937, 17003, 17209.
Sprinkling roof and sides would be inadequate, 17210.
Frequency with which necessary, 16883 (*par.* 2), 16939.
Hose and stand-pipe system with sprays attached to pipes in very dusty mines advocated, 16883 (*par.* 2), 16919, 16926, 16999.
Cost of, 16985.
Zones, watered:
Advantages of, probability of arrest of explosion by, &c., 16883 (*pars.* 2 and 5), 17097, 17162, 17172.
Report by Dr. Haldane and others on watering in Westphalian mines, suggestion as to zones contained in, 17231.
Wingate Colliery Explosion:
Afterdamp, majority of deaths caused by, 17126.
Safety from afterdamp, question as to possibility of, 17131.
Arrest of, 17111, 17119, 17202.
Cause of—shot-firing, 17140, 17282.
Course traversed by, 17101, 17127, 17200.
Zone, apparently dustless, traversed by: views of Witness that dust was present in this zone, 17103, 17200, 17203.
Coroner's inquest, evidence at, as to brushing away combined with watering, 16928.
Dust, no previous explosion from, in this mine, 17056.
Rescue apparatus could not have been used to any advantage at, 17236.
Zones, dustless; positions in which zones might have been placed, views as to, 17066, 17071.
Zones, *see title* Dust, *sub-heading* Prevention, and *title* Watering, *sub-heading* Zones.

CHAMBERS, Mr. W. H., Managing Director of the Denaby and Cadeby Main Collieries, Ltd. (*South Yorkshire Coal Owners' Association.*) (*See questions* 15171—15448.)

CHAMBERS, Mr. W. H.—*cont.*
Cadeby and Denaby Collieries:
Arching, 15171 (*par.* 4), 15188, 15448.
Electric cables, covered, 15386.
Explosion in Denaby Colliery, cause of, 15301.
Hygrometer tests, table of, 15171 (*par.* 4).
Oak logs, use of, instead of arching, 15448.
Roof and sides, effect of ordinary working of mine on, 15171 (*par.* 4), 15347.
Screening plant, dust from:
Amount of, 15355, 15404, 15410.
Character of dust, 15408.
Fans and pipes for collection of, 15171 (*par.* 9), 15208.
Period taken to collect dust, 15405.
Sale of dust, 15356.
Timbering, systematic, 15171 (*par.* 9), 15218.
Watering, extent possible, 15181.
Deep Mines:
Arching, difficulty of maintaining in, 15294.
Future coal supplies will be drawn from, 15326.
South Yorkshire mines, depth of, 15171 (*par.* 4), 15323.
Dust in Mines:
Explosions:
Cause of, 15171 (*par.* 13), 15261, 15286, 15296, 15403, 15412.
Amount of dust required to cause an explosion, 15261.
Experiments as to:
Advisability of, 15171 (*par.* 13), 15242, 15295.
Rhodes, Mr., experiments by, 15336.
Suspended fine dust as cause of explosion, views as to, 15171 (*par.* 15), 15261, 15286, 15403.
Experience as to (absence of any explosion in mines worked by Witness for 40 years), 15171 (*par.* 9), 15225.
Surface, dust at, causing explosion, views as to whether possible, 15411.
Prevention or removal of, by methods other than watering:
Arching:
Difficulty of maintaining in deep mines, 15294.
Steel arching in use in Cadeby Colliery, 15171 (*par.* 4), 15188.
Brushing away, views as to and extent to which practised in mines worked by Witness, 15171 (*par.* 8), 15200, 15259, 15353.
Compulsory prevention as far as possible, General Rule as to, views as to whether desirable, 15361.
Haulage, slow, effect of, on amount of dust deposited, 15171 (*par.* 15), 15249.
Salt, sprinkling, unsatisfactory results of, 15171 (*par.* 8), 15187, 15196, 15258.
Screening plant, dust from, 15355, 15358.
Explosion of dust at surface, questions as to possibility of, 15411.
Fans and pipes, for exhaustion of, in use at Cadeby Colliery, 15171 (*par.* 9), 15208, 15405.
Inflammability as compared with other dusts, 15208.
Removal of screens to distance from downcast shaft, 15171 (*par.* 15).
Sprays in downcast shaft, views as to, 15171 (*par.* 15), 15247.
Wagons, *see that title.*
Watering (damping) dust before brushing away, views as to, 15200, 15274.
Zones (dry, dustless), views as to:
Advantages of, comparison with wet zones as to, 15252, 15273.
Arrest of explosion by, doubtful, 15252, 15274, 15433.
South Yorkshire mines, dust in, 15171 (*par.* 3), 15177, 15179.
Prevention, methods of, 15171 (*par.* 8).
Electricity:
Cables, covered:
Advisability of, 15171 (*par.* 12), 15399.
Denaby and Cadeby Collieries, use of, in, 15386.
Coal-cutters, electric, 15392.
Covering of cables, impossibility of, 15399.

Digitized by Google

CHAMBERS, Mr. W. H.—*cont.*
Electricity—*cont.*
Motors, enclosed, advocated, 15171 (*par.* 12), 15386.
Rules, adequacy of, if properly interpreted, 15385.

Experiments as to dust, advisability of, 15171 (*par.* 13), 15242, 15295.
Rhodes, Mr., experiments by, 15336.
Zones, dustless, experiments as to advocated, 15252, 15275, 15433.

Explosions:
Causes of, enumerated, 15171 (*par.* 12), 15304 15366.
Non-preventible causes, 15301, 15317, 15321, 15421.
Experience as to (no explosion in mines worked by Witness during last 40 years), 15171 (*par.* 9), 15314.

France, mines in, visited by Witness, 15171 (*par.* 9), 15174.
Dust, character of, 15175.
Fans and pipes for collection of dust in use at Mines de Dourges, 15171 (*par.* 9), 15404.

Germany:
Mines, Westphalian, visited by witness, 15174, 15328, 15344.
Character of, as to dust, 15175.
Watering: exemption system, 15171 (*par.* 16), 15256, 15328, 15440.
Precautions against dust in exempted mines, 15337.

Haulage:
Dust, accumulation of, would be decreased by slow haulage, 15171 (*par.* 15), 15249.
Safety gates invented by Witness and introduced into South Yorkshire collieries, 15171 (*par.* 9).

Lancashire:
Safety lamps, Special Rule as to, conversion into General Rule, views as to whether desirable, 15238.

Maclaren Explosion:
Cause of, varying theories as to, 15425.
Zones, dustless, question whether explosion might have been arrested by, 15433.

Owners:
Attitude of, as regards safety of mines, 15171 (*pars* 9, 10, 11).
Freedom to adopt alternative methods to watering advocated, 15171 (*par.* 12), 15230, 15255, 15293, 15311, 15434.

Qualification of Witness, 15172.

Safety Lamps:
Acts of Parliament, Rules, &c.:
General Rule 8 as to, adequacy of views as to, 15234, 15381.
Lancashire Special Rule as to, conversion into General Rule, views as to whether desirable, 15238.
Compulsory introduction of, views as to whether desirable, and as to circumstances justifying, 15171 (*par.* 12), 15231, 15255, 15293, 15311, 15381.
Explosion caused by damaged lamp, question as to possibility of, 15422.
Objection on part of men to introduction of, frequency of, 15237.

Shot-firing:
Abolition, as far as possible, in South Yorkshire mines, 15171 (*par.* 14), 15367.
Acts of Parliament, Orders, Regulations, &c.: adequacy of, if strictly observed, 15171 (*par.* 18), 15311, 15369.
Strengthening as regards roadways, views as to, 15371.
Between shifts:
Practice as to, in South Yorkshire district, 15171 (*pars.* 14 and 18), 15243.
Prohibition, except between shifts, advocated as regards main roadways, 15171 (*par.* 18), 15244, 15371.
Explosions caused by, 15171 (*par.* 13), 15296, 15366.
Blown-out shots, 15411.
Notice to manager and permission from him before shots are fired in main roadways, views as to, 15372.

CHAMBERS, Mr. W. H.—*cont.*
Shot-firing—*cont.*
Number of shots to be fired simultaneously; one only advocated; period to elapse between each shot, 15376.

Thorncliffe Colliery Explosion, cause of, 15301.

Timbering:
Accidents from falls of roof and sides, number of not decreased apparently by new timbering rules, theory explaining, 15220.
Systematic, introduced by Witness, 15171 (*par.* 9), 15218.

Wagons:
Dust-tight, advantages of, type advocated, &c., 15171 (*par.* 15), 15211, 15246, 15276, 15360.
Watering of coal in, injurious to some kinds of coal, 15277.

Walker, Mr., evidence of, reference to, 15171 (*par.* 9), 15208.

Water, Natural, in mines: Table of hygrometric tests, 15171 (*par.* 4).

Watering:
Compulsory, views as to:
Owners should have right to choose alternative methods of preventing explosions, 15171 (*par.* 12), 15255, 15293, 15311, 15434.
Exemptions would be necessary, 15171 (*pars.* 4 and 16), 15256, 15257, 15351, 15448.
Dangers and difficulties of:
Effect on roof and sides, 15171 (*par.* 4 and 8), 15181, 15188, 15190, 15281, 15448.
Pickering, Mr., tests made by, 15171 (*par.* 4).
Health of miners, effect of on, 15171 (*par.* 17), 15253.
Extent necessary; watering of floor alone inadequate, 15187.
Hose for watering floor, 15171 (*par.* 8).
Local conditions, consideration of, importance of, in considering systems of watering, 15171 (*par.* 16).
Sprays in intake, 15171 (*par.* 8), 15195.
Zones, watered:
Advantages of, if complete watering is impracticable, 15171 (*par.* 16), 15251, 15270.
Arching, 15171 (*par.* 16).
Arrest of explosion by, experiments as to advocated, 15171 (*par.* 16) 15433.

Zones, *see title* Dust, *sub-heading* Prevention, and *title* Watering, *sub-heading* Zones.

FORGIE, Mr. JAMES TENNANT, Director of Messrs. William Baird and Company, Ltd. (*Scottish Coal Owners*). (*See questions* 17548—17979).

Ayrshire, safety lamps not used in, 17756.

Barwood Colliery, Kilsyth:
Character of coal, 17835, 17836.
Explosions and ignitions of gas, small; no instance of dust explosion, 17838.
Longwall system of working, danger of dust increased by, 17840.

Blantyre, Dixon's Collieries, explosion at, 17780.
Area, 17783.
Cause of, 17548 (*par.* 4), 17780.
Course traversed by, 17786.
Method of working colliery, 17789.
Safety lamps, type used, 17791.

Bothwell Colliery, employment of foreign workmen at, 17799.

Coal Mines Regulation Act, 1887:
Adequacy of regulations under, if strictly observed, 17548 (*par.* 21), 17617.
Strengthening, suggestions as to, 17619.
Accidents, report of, regulations as to, 17679, 17683.
Gas, report of feeder, regulation as to, 17746.
Manager's certificate of competency, regulation as to, 17772.
Ventilation, General Rule 1 as to, 17747.

Delevingne, Mr., evidence of, reference to, 17548 (*par.* 7).

Denny Colliery Explosion, 17548 (*par.* 4), 17553.
Arrest of, by harmless dust mixed with inflammable dust, views as to, 17566, 17569.

Digitized by Google

FORGIE, Mr. J. T.—*cont.*
Denny Colliery Explosion—*cont.*
Cause of (dust), 17548 (*pars.* 4 and 9), 17556, 17804.
Course traversed by, 17801.
Deaths, number of, 17680.

Doors, arrest of explosions by, views as to, 17559.

Dust in Mines:
Danger from:
Extent to which realised by miners, 17548 (*par.* 7), 17551.
Longwall and stoop and room workings, danger in, relative effects of, on danger from dust, 17789, 17840.
Denny Colliery, dust in, 17618, 17800, 17831, 17833.
Experiments, *see that title.*
Explosions:
Cause of, 17787.
Amount of dust required to cause an explosion:
Experiments as to, advocated, 17587, 17613, 17899.
Small amount more dangerous than large, Witness cannot give an opinion on this point, 17588, 17827.
Number of, 17548 (*pars.* 7 and 9).
Removal or prevention of dust would remove chief cause of spread of explosions, 17548 (*par.* 3), 17732.
Face, dust at, danger from is small as compared with danger from dust in haulage road, 17548 (*par.* 18), 17844.
Inflammability of various kinds of dust, 17823.
Experiments as to, *see title* Experiments.
Method of working, effect of: stoop and room system, 17840.
Mixing, mechanical, of foreign material with dust, 17548 (*par.* 14), 17840.
Possibility of explosion separating mechanically-mixed material from other material, 17819.
Prevention or removal of:
Air-blasts, views as to this suggestion, 17616.
Brushing away, views as to, 17548 (*par.* 20).
Amount of dust that would probably be left, and views as to whether sufficient to cause an explosion, 17613, 17696.
Compulsion as to, views as to whether desirable, 17888.
Discretion of manager as to method advocated, 17901.
Screening plant, dust from, probably not a serious danger, 17548 (*par.* 23).
Zones, dry, dustless (brushed dry), suggestions as to, 17548 (*par.* 22).
Arching, necessity for, 17548 (*par.* 22), 17659.
Length of zone, experiments as to, advocated, 17548 (*par.* 22), 17732.
Scotland, *see that title.*

Edinburgh District, gradient of mines, 17693.

Experiments as to dust:
Amount required to cause or carry on an explosion, experiments as to, advocated, 17587, 17899.
Government Department for, advocated, 17548 (*pars.* 12, 15, 16).
Hall, Mr., experiments by, with dust from Scotch mines, 17548 (*pars* 11 and 13), 17556, 17567.
Inflammability of various kinds of dust, experiments as to, advocated, 17821, 17823, 17911.
Mechanically and chemically mixed material, experiments as to, advocated, 17822.
Shot-firing: watering in neighbourhood of a shot, experiments as to, advocated, 17622, 17810.
Zones, length of, experiments as to, advocated, 17548 (*par.* 22), 17732.

Explosions:
Doors, arrest by, views as to, 17559.
Dust, *see that title.*
Flame going before explosion, 17560.
Scotland, *see that title.*

Explosives, Permitted, absolute safety not ensured by use of, 17847.

FORGIE, Mr. J. T.—*cont.*
Explosives Order 1906:
Adequacy of, if strictly observed, 17548 (*par.* 21).
Detonator, conditions as to use of, advocated, 17884.
Face and haulage roads, different regulations for, 17847.
Making of shot-hole, general regulations for and views as to whether more explicit regulations are desirable, 17852, 17858.
Official or man firing shot, qualification of, conditions as to, 17761, 17880.

Fife District, gradient of mines, 17693.

Germany, Watering System:
Hose-pipes, use of, 17930.
Introduction into England undesirable, 17892.

Hamilton District, safety lamps used in, 17719, 17756, 17792.

Lanarkshire, fiery mines in, 17778.

Lancashire: shot-firing, Special Rules as to:
Marking out of direction of shot, Rule as to, 17863, 17868.
Notice to manager, General Rule on lines of, advocated, 17602.

McLaren, Mr., evidence of, reference to, 17618.

Managers:
Certificate of competency, regulations as to, 17772.
Responsibility of, 17762, 17906.

Qualifications of Witness, 17548, 17549, 17698.

Ronaldson, Mr., evidence of, reference to, 17618.

Safety Lamps, use of, in Scotland, views as to, *see title* Scotland, *sub-heading* Safety Lamps.

Scotland:
Accidents:
Number of, from falls of roof and sides, and from haulage:
Return showing excess over number of explosions, 17548 (*par.* 10), 17573.
Safety lamps, use of, would probably increase number of these accidents, 17548 (*par.* 9), 17576, 17684, 17713, 17759, 17904, 17932.
Report of, regulations as to, 17679, 17683, 17950.
Barwood Colliery explosion, Kilsyth, cause of, 17548 (*par.* 4).
Blantyre Colliery explosion, *see title* Blantyre.
Denny Colliery explosion, *see that title.*
Dust in mines:
Character of Baird & Co.'s collieries and of Scotch collieries generally as to dust, 17831, 17915. 17924.
Danger from:
Extent to which realised and dealt with, 17548 (*pars.* 1, 2 and 3), 17550, 17937.
Not very serious in Scottish mines, 17548 (*pars.* 7 and 14).
Exemption of mines from stringent regulations advocated, 17548 (*par.* 21), 17618.
Explosions of dust: one only in Baird & Co.'s Collieries, 17554.
(*See also titles* Denny Colliery Explosion *and* Blantyre Explosion.)
Inflammability of various kinds of coal dust:
Difference of opinion between management and inspectors as to, 17548 (*par.* 14).
Galloway, Mr., analysis by, 17548 (*par.* 14), 17589.
Hall, Mr., analysis by, 17548 (*pars.* 11 and 13), 17556, 17567.
Prevention:
Brushing away:
Amount of dust that would probably be left, and questions as to whether sufficient to cause an explosion, 17613, 17696.
Zones (dry), arching, difficulty as to, 17896.
Screening plant, dust from:
Danger from, small, owing to dampness of shaft, 17548 (*par.* 23), 17661.
Prevention of, by fans or other method, not considered, 17662.

Digitized by Google

FORGIE, Mr. J. T.—*cont.*
Scotland—*cont.*
Explosions:
Experience of Witness as regards, 17727.
Firedamp, number of explosions from, 17548 (*par.* 9).
Ignitions of gas, as distinguished from explosions, 17704, 17741, 17939.
Brushing out of gas very little practised. Hurdle-screens occasionally put up, 17935, 17943.
Number of, and death-rate from explosions, 17548 (*pars.* 4 and 7), 17573, 17680, 17685.
Small explosions occurring chiefly in open light mines, number of, 17548 (*par.* 7), 17570, 17679, 17699, 17736, 17742.
Report of, law as to, 17680, 17683, 17950.
Explosives, permitted:
Supply by owners to men advocated; objections to men purchasing from shops, 17961, 17970.
Storage in miners' houses, objection to, 17961, 17969.
Use of in Baird & Co.'s Collieries, 17958.
Explosives Order, adequacy of, views as to, 17617.
Points in which strengthening is desirable, 17619.
Foreign workmen, employment of (Bothwell Park Colliery), 17794.
Gradient of steep mines, 17693, 17711.
Haulage accidents, number of, would probably be increased by introduction of safety lamps, 17760.
Notice of Accidents Act, as to report of accidents. 17953.
Safety lamps:
Accidents from falls of roof and sides, and from haulage, number of, would probably be increased by introduction of safety lamps, 17548 (*par.* 9), 17576, 17684, 17713, 17722, 17759, 17904, 17932.
Compulsory introduction of, in mines where watering or brushing away are impracticable, views as to, 17903.
Denny Colliery, care of in, 17734.
Explosions, number of, in mines where safety lamps are not used, 17548 (*par.* 7), 17570, 17575, 17679, 17699, 17704, 17736.
Extent to which naked lights are used as compared with safety lamps, 17548 (*par.* 6), 17719, 17737, 17756.
Objection to introduction of, both on part of owners and men, 17715, 17812.
One only to each man, 17694.
Re-lighting, difficulty of, 17691.
Return to open lights after introduction of safety lamps, question as to, 17814.
Steep workings, increased use of safety lamps in, undesirable, 17689, 17711.
Types advocated and types used, 17791, 17818.
Shot-firing:
Abolition of, views on this point, 17548 (*par.* 18), 17902.
Acts, Orders, Regulations, &c.:
Adequacy of, if strictly observed, 17548 (*par.* 21), 17887.
Detonators, conditions as to use of, 17885.
Drilling, stemming and blasting, regulations as to, 17850, 17852.
More explicit directions, views as to whether desirable, 17858.
Face and haulage roads, different method of dealing with, under, 17845.
Between shifts:
At night in main haulage roads and in stone-work, views as to, 17548 (*par.* 18), 17595.
Prohibition of shot-firing except between shifts impracticable in many mines, 17548 (*par.* 18).
Blown-out shots, 17847.
Electrical firing apparatus or fuse, 17883.
Miss-fire shots:
Lancashire Special Rule as to marking out direction of shot, views as to whether adoption of is desirable, 17863, 17868.
Withdrawal of men, views as to, 17869.

FORGIE, Mr. J. T.—*cont.*
Scotland—*cont.*
Shot-firing—*cont.*
Notice to manager and permission from him before shot is fired in main haulage road, views as to, 17548 (*par.* 19), 17601, 17877.
General Rule advocated, 17603.
Number of shots to be fired simultaneously, views as to, 17871.
Official, special, for shot-firing:
Appointment of: question of competency left to manager; certificate unnecessary, 17761, 17905.
Limitation of shot-firing to, views as to, 17663, 17668.
Permitted explosives, appointment in cases of use of, 17880.
Penalties for infringement of rules, increase advocated, 17623.
Single individual not to carry both explosive and means of firing it; views of Witness as to this suggestion, 17624, 17674, 17884.
Watering in neighbourhood of a shot:
Area to be watered, increase advocated, 17621, 17676, 17810, 17876, 17887.
Difference of opinion between inspectors and management as to necessity for, 17548 (*pars.* 14 and 15).
Ventilation:
Explosions occurring in mines where gas has been found and reported, 17746.
Ignition of gas, distinction from explosion, 17704, 17741, 17939.
Brushing out of gas very little practised; hurdle screens sometimes erected, 17935, 17943.
Wagons:
Dust-tight, type advocated, &c., 17548 (*par.* 8), 17604.
Lighting, not practised in self-acting inclines, 17582.
Repair of, 17610.
Compulsion as to, views as to, 17611.
Water, natural, in pits, 17548 (*par.* 8), 17919.
Watering:
Compulsory universal, objections to, 17548 (*par.* 17), 17590.
Character of mine in which possible, 17917.
Denny Colliery, watering in, 17832.
Experience of Witness as to, 17931.

Shot-firing, *see title* Scotland, *sub-heading* Shot-firing.

Truck Act, in relation to supply of explosives to men by owners, 17962.

Udston Colliery Explosion:
Cause of, 17548 (*par.* 4), 17780.
Safety lamp, type used, 17791.

Wagons:
Dust-tight, suggestion as to, 17548 (*par.* 20).
(*See also title* Scotland, *sub-heading* Wagons)

Watering:
Character of mines in which possible, 17917.
Compulsory universal, objection to, 17548 (*par.* 17), 17590, 17892.
Extent required:
Damping inadequate, 17930.
Floor only: views as to whether adequate, 17615.
Zones, suggestion as to, 17548 (*par.* 22), 17913.
Advantage of wet as compared with dry zones, 17659, 17897.
Arching, views as to, 17657, 17894.
Difficulty of, when seam is worked over or under the arch, 17895.
Length, views as to, 17548 (*par.* 22), 17732.

Wingate Explosion:
Cause of—shot-firing: one man carrying detonator as well as explosive, 17636, 17639.

FOWLER, Mr. GEORGE, Agent to the Babbington Coal Company, Nottingham. (*See questions* 10997-11331).

Accidents:
Falls of roof and sides, most frequent cause of accidents, 11165.

Digitized by Google

FOWLER, Mr. G.—*cont.*

Ankylostomiasis :
Alpine Tunnel, outbreak in, 11272.
Watering in deep mines, production by probable, 11000 (*par.* 16), 11270.
Westphalian mines, 11270.
Cornwall, outbreak in, 11274.

Chesterfield and Midland Counties Institute of Engineers, Paper read by Witness before, on "How a Mine may be Dry and not Dusty," 11001.

Coal Mines Regulation Act, General Rule 12, as to watering in neighbourhood of a shot, importance of 11099.

Cornish Mines :
Ankylostomiasis in, 11273.
Timbering, effect of watering on, 11288.

Courrières Mine, accident at: effect of underground intercommunication, and steps taken by Witness to prevent similar disaster in Babbington Colliery, 11195.

Doors separating one set of workings from another, 11191.
Plates illustrating, 11194.

Dust in Mines :
Analysis of dust: samples from Babbington Colliery, 11095, 11328.
Boiler explosions, possible effect of upon dust, 11219.
Causes of, 11000 (*pars.* 2, 3 and 4), 11009.
Experiments as to, advocated, 11209, 11241.
Face, amount at and character of, 11005.
Inflammability :
Most explosive dust probably that on roof and sides of return airways, 11000 (*par.* 4), 11008.
Prevention or removal of, views as to :
Jets of compressed air, 11025, 11039.
Screening plant, dust from, going down down-cast shaft, 11000 (*par.* 4), 11013, 11255.
Distance of screening plant from shaft, 11013, 11111, 11255.
Spraying of down-cast shaft, 11015.
Vacuum cleaner, suggestions as to, 11000 (*par.* 12), 11090, 11181, 11268.
Cost of, estimate of, 11184.
Wagons, dust from, *see title* Wagons.
Whitewashing machine, 11000 (*par.* 11), 11256.
Zones, dry, dustless, suggestions as to, 11000 (*par* 6 *et seq.*), 11018, 11023, 11025, 11047, 11055, 11187, 11250, 11284.
Afterdamp, 11259.
Arrest of explosion by, views as to whether possible, 11059, 11062, 11158, 11232, 11238.
System has never been tested by an explosion, 11058, 11063, 11076, 11231.
Babbington Company's Colliery, practice as to in, 11000 (*par.* 17), 11038, 11050, 11058, 11076, 11231.
Cost of, 11040.
Extent of sweeping, 11068.
Length of zones, 11243.
Nature of roof and plates showing treatment of roof and sides, method of timbering, &c., 11048.
Plan of workings, 11173.
Character of mines as to dryness and dustiness in relation to this suggestion, 11223A.
Cost of estimate of, 11018, 11040, 11116, 11158, 11250.
Experiments advocated, 11241.
Extent of sweeping required, 11035, 11068, 11081, 11119.
Length of zones, 11019, 11057, 11234, 11265.
Paved roadways, general advantage of, 11000 (*par.* 6), 11115.
Treatment of roof and sides, 11000 (*pars.* 7 and 8), 11024, 11048, 11055, 11187.
Watering, extent advocated, 11028.
Samples of dust, 11095.
Wagons, dust from, *see title* Wagons.

FOWLER, Mr. G.—*cont.*

Explosions :
Doors for separation of one set of workings from another, use of in relation to, 11191.
Sketch of doors, 11194.

Explosives :
Bellite, substitution of, for gunpowder, 11096.

Galloway, Professor, evidence of, reference to, 11092.

Germany :
Watering, universal, with exceptions in certain cases, 11170.
Westphalia :
Ankylostomiasis, outbreak of, 11270.
Watering in, 11270.

Lancashire Collieries, Longwall workings, 11282.
Wagons, dust-tight, use of in, 11280.

Method of Working Mines, 11282.

Moira Collieries :
Dust, prevention by paved roads kept clean by sweeping, 11025, 11031.
Output, 11026.

Shot Firing :
Act of Parliament: General Rules, Orders, &c. :
Strict observance of, would probably greatly reduce number of accidents, 11123, 11125, 11199.
Dust prevention or removal would still be necessary, 11218.
Between shifts: prohibition of all shot-firing except between shifts, views as to whether desirable, 11103, 11212.
Danger of, in main roadways, 11123, 11261.
Deputies, shot-firing done entirely by, 11129.
Face, shot-firing in, 11128.
Notice to managers before shot-firing, advocated, 11102, 11123, 11217.
Officials, shot-firing by, in Babbington Colliery, 11129.
Practice as to, in Babbington Colliery, 11102, 11123.
Small coal left in gob, question as to shot-firing in cases of, 11133.
Watering in neighbourhood of a shot, necessity for, 11097.
Extent advocated, 11099, 11123.

Small Coal :
Dust accumulation from, question as to, 11227.
Shot-firing in cases of small coal left in gob, views as to, and as to explosiveness of small coal, 11133.

Stokes, Mr., evidence of, reference to, 11196.

Timbering :
Accidents, number of, in relation to, 11299, 11318,
Babbington Colliery, system in force at, described in detail, 11290 *et seq.*
Distance between bars in working face, 11315, 11324.
Plate illustrating, 11290.
Special men not employed, 11305.
Steel props, 11290, 11320.
Watering, possible effect of, 11000 (*par.* 15), 11288.

Wagons, dust from, 11000 (*pars.* 3 and 5).
Cause of dust in mines, extent of, 11083.
Dust-tight wagons, advantages of, 11000 (*par* 3), 11009, 11073, 11075, 11105, 11151, 11177, 11223A, 11225, 11236, 11275, 11279, 11288.
Iron-bodied wagons not very satisfactory in working, 11000 (*par.* 5), 11009.
Loading wagons, method advocated, 11107.
Wooden wagons, advantages of, 11000 (*par.* 5), 11009.

Watering :
Ankylostomiasis, probable production by, in deep mines, 11000 (*par.* 16), 11270.
Bars in roof, &c.: dust from would probably be only imperfectly removed by, 11,000 (*par.* 14).
Compulsory watering, or General Rule as to watering, views as to whether desirable, 11,000 (*par.* 16), 11170, 11178.

Digitized by Google

FOWLER, Mr. G.—*cont.*
Watering—*cont.*
Dangers and difficulties of, 11000 (*pars.* 14, 15 and 16), 11126, 11162.
Effect on roof and sides, 11000 (*pars.* 14 and 15), 11164, 11166.
Health of miners would probably be affected in deep mines, 11000 (*par.* 16).
Increase of dust by intermittent watering, 11000 (*par.* 14).
Timbering and steel girders, probable injury to, 11000 (*par.* 15), 11288.
Warwickshire mines particularly unsuitable for watering, 11167.
Depth of mines in relation to, 11000 (*par.* 16).
Face, watering at, views as to, 11004, 11272.
Zones, *see title* Dust, *sub-heading* Prevention.

GALLOWAY, Professor W., Mining Engineer, Late Professor of Mining of the University College of South Wales and Monmouthshire. (*See questions* 10168—10544.)
Abercarn Colliery, explosion at, arrest of by slightly damp area, 10173 (*pars.* 28 and 33), 10208.
Accidents :
Falls of roof and sides, number of accidents from as compared with explosions, 10428.
Altofts Colliery, Explosion at :
Arrest by road damp from water carried to stables, 10173 (*pars.* 29 and 33).
Course traversed, 10173 (*par.* 10 *et seq.*), 10469.
Report and Paper by Professor Galloway on, 10173 (*pars.* 8 and 9), 10187.
Wagons, dust from, 10173 (*par.* 11), 10186, 10341, 10471.
Water spilt from pails in watering horses, arrest of explosion by, 10173 (*pars.* 29 and 33).
Belgian Mines, dust in, 10180.
Cadeby Main Colliery, fans and pipes for exhausting dust, 10532.
Clydach Vale Explosion, mine watered the day before, 10526.
Coal Mines Regulation Act, Section 49, General Rule as to shot-firing, strengthening advocated, 10250.
Courrières Mine, explosion in, vortex rings possibly the cause of, 10264, 10272, 10287.
Depth of dusty mines, 10173 (*par.* 1), 10174, 10372.
Dust in Mines :
Dangerous character of as compared with gas, 10390.
Explosions in relation to :
Cause of explosions, extent to which dust is operative as, 10295, 10319, 10325, 10389.
(*See also titles of Explosions, as* Altofts, Courrières, &c.)
Face of mines, comparative freedom from dust except in very brittle coal and in narrow headings, 10173 (*par.* 2), 10179, 10308, 10463.
Prevention or removal by other methods than watering, 10173 (*pars.* 36 and 42), 10219, 10459.
Arching of brick, 10173 (*par.* 36), 10222, 10227, 10455.
Calcium chloride, 10173 (*par.* 39), 10235.
Mixing dust with non-inflammable substance), 10173 (*par.* 36), 10231, 10238, 10358.
Experiments as to, 10416, 10501.
Method of mixing, 10239.
Frequency with which process must be repeated, 10241.
Health of miners, question as to effect on, 10241.
Motor-Cars, experiments as to dust-prevention, 10366
Roadways, main haulage, danger of explosions is chiefly confined to : importance of keeping clear from dust, 10173 (*par.* 3), 10307, 10314, 10322.
Salt, sprinkling with, 10173 (*pars.* 38 and 39), 10232, 10365.
Screening plant, dust from going down downcast shaft, 10173 (*par.* 4), 10379, 10532.
Sprays in downcast shaft, 10534.
Steam jets in downcast shaft, 10173 (*par.*44), 10302, 10533.
Wagons, dust-tight, *see title* Wagons.
Sources of, summary of, 10173 (*par.* 4).
Wagons, dust in, *see title* Wagons.
Watering in relation to dust, *see title* Watering.

GALLOWAY, Professor W.—*cont.*
Explosions :
After-damp, checking can be by physical barrier only, 10216.
Dust in relation to, *see title* Dust.
Face, explosions traversing, 10463.
Iron doors to arrest, 10173 (*par.* 35), 10216.
Number of, as compared with accidents from falls of roof and sides, 10428.
Safety-lamps, explosions caused by firedamp from, 10426, 10448.
Shot-firing as a cause of, 10313, 10315, 10371, 10424.
(*See also titles of Explosions, as* Altoft's, Courrières, &c.)
Germany, watering in :
Cost of, 10173 (*par.* 23), 10476.
Qualifications of man having charge of watering, 10514, 10536.
Systems adopted, 10173 (*pars.* 22 and 23), 10198, 10200.
Thorough system (face and airways watered, as well as haulage roads), 10542.
Westphalia, watering in :
Exemption of some mines, 10506.
Hose system, 10512, 10517.
Qualifications of man in charge of watering, 10514.
Llwynpia Colliery, watering in, 10173 (*par.* 25), 10483.
Nixon's Navigation Collieries : Dust, treatment with calcium of chloride, 10173 (*par.* 39).
Park Slip Explosion, damp floor traversed by, 10496.
Pochin Colliery :
Explosion arrested by slightly damp condition of road, 10173 (*par.* 26), 10204.
Steam in downcast shaft, 10173 (*par.* 44), 10305.
Railway Trucks, amount of dust falling from as compared with dust from wagons in mines, 10173 (*par.* 6), 10184, 10343.
Safety Lamps, defective, explosions caused by, 10426, 10448.
Seaham Colliery, visited by witness after the explosion, 10470.
Shale Dust, inability to carry an explosion, 10358.
Abel, Sir F., experiments, 10361, 10363.
Shot-Firing :
Abolition of, views as to, 10420, 10432.
Mines in which shot-firing has been abolished, 10439.
Cause of accidents and explosions, extent of, 10313, 10315.
Strict observance of existing rules would check main source of accidents, 10371, 10424.
Vortex rings, 10252, 10330, 10337, 10384.
Watering in neighbourhood of a shot, 10225.
Advantages of, as compared with watering of whole of wagon ways, 10328.
Headings near face, 10308.
Methods of and extent of, consideration of, 10173 (*par.* 43), 10247, 10334.
Zone required, 10273, 10327.
Welsh steam coal mines, shot-firing unnecessary in, 10443.
South Wales :
Watering :
Timbering, cost of, in relation to, 10413.
South Wales Institute of Engineers, Paper read by Witness before, 10249.
Staffordshire Mines, treatment of dust by sprinkling salt on floor of mines, 10173 (*par.* 38).
Stokes, Mr., evidence of, reference to, 10173 (*pars.* 24 and 35), 10202, 10405.
Temperature of mines, increase by use of steam pipes 10374.
Timbering, cost of, 10413.
Universal Colliery Explosion :
Course traversed by, 10467.
Shot-firing :
Cause of explosion, uncertainty as to, 10317.
Vortex ring, 10255, 10258, 10263, 10266.
Wagons :
Dust from, 10173 (*pars.* 45 and 67), 10183.
Dust-tight iron wagons, views as to, 10173 (*pars.* 6 and 7), 10185, 10192, 10341.
Springs and Buffers, suggestion as to, 10173 (*pars.* 6 and 7), 10185, 10346, 10392.
Cost, estimate of, 10395.
Weight carried by, 10396.

Digitized by Google

GALLOWAY, Professor W.—*cont.*

Walker, Mr., evidence of, reference to, 10532.

Watering in Mines:
Compulsory watering, views as to, 10410.
Cost of, 10173 (*par.* 23).
Difficulties and dangers of, 10356, 10406.
Effect on roof and sides, 10406, 10505, 10508, 10516.
Explosions in relation to:
Arrest of explosion by slightly damp area, instance of, 10173 (*par.* 26 *et seq.*), 10204, 10208, 10210.
Failure of damp area to arrest explosion, instances of, 10493, 10496, 10526.
(*See also titles of Explosions, as* Altofts, &c,)
Extent of, in Welsh mines, 10173 (*par.* 24), 10202, 10405.
Extent required, views as to:
Floor alone, adequacy of, without watering of roof and sides, views as to, 10173 (*pars.* 25, 26 and 27), 10211, 10404.
Glamorgan Coal Company's mines formerly watered in this way, 10484.
Instances of explosion travelling over damp floor, 10496.
Slightly damp area, adequacy of, to arrest explosion, 10173 (*par.* 26 *et seq.*), 10202 10204, 10208, 10210, 10493, 10526.
(*See also sub-heading* Zone Watering.)
Hose and stand-pipe system, 10173 (*pars.* 21 and 23), 10198, 10400.
Qualifications desirable in man in charge of watering, 10536.
Roadways: importance of watering haulage roads, 10308.
Shot-firing in relation to, *see title* Shot-firing.
Sprays and stand-pipes, system of, 10173 (*pars.* 21 and 22), 10195, 10400.
Attitude of miners as to, 10401.
Superseded largely by stand-pipe and hose, 10173 (*par.* 22), 10400.
Timbering, cost of, in relation to, 10413.
Watering-tram, use of, 10173 (*par.* 25).
Zone watering, views as to, 10173 (*par.* 33), 10354.
Length of zone necessary, 10173 (*pars.* 33 and 34), 10208, 10213, 10488.
Number of zones required in a long haulage road or intake, 10225.
Placing of zones, consideration necessary, 10224.

Westphalia, *see title* Germany.

Zones, *see title* Watering, *sub-heading* Zones.

GARFORTH, Mr. W. E., Chairman of Messrs. Pope and Pearson, Ltd., Altofts Collieries, Normanton. President of the Mining Association of Great Britain. (*West Yorkshire Coal Owners' Association*), &c, &c. (*See questions* 15617A—15937.)

Accidents:
Number of, from falls of roof and sides as compared with number of explosions, 15685.

Altofts Collieries:
Explosion on October 2nd, 1886:
Account, general, of, 15617A, 15619 *et seq.*
Amount of dust, 15634, 15645, 15669.
Arrest of:
By road damp from water carried to stables, 15637, 15645, 15656, 15660, 15906.
By engine-house wall, 15637, 15643, 15657.
Point at which explosion gradually died away, 15635.
Cause of, shot-firing in dusty atmosphere, 15617A, 15622, 15644, 15652, 15831.
Explosive used—gunpowder, 15652.
Course taken by and damage done by, 15628 *et seq.*, 15651, 15652A, 15658, 15668, 15905.
Gas, absence of, 15635.
Plates, illustrating, 15617A.
Precautions taken subsequently to, 15670, 15674, 15822, 15899.
Pressure, 15904, 15910.
Symptoms of men, indications as to pressure afforded by, 15913.

GARFORTH, Mr. W. E.—*cont.*

Altofts Collieries—*cont.*
Method of working (straight line of face), freedom from accidents resulting, 15617A, 15621, 15682, 15684, 15773, 15851, 15922.
Adoption of, in other collieries, question as to, 15690.
Coal-cutters, use of, essential, 15692, 15851, 15923.
Description of method, 15776, 15923.
Plates illustrating, 15682, 15692.
Timbering, system of, in connection with, 15684, 15689, 15776, 15777, 15781.
Pillar left at sinking of pit in 1863, size of, 15634.
Rescue gallery at, 15792.
Plan of, 15792.

Blackett, Mr., evidence of, reference to, 15931, 15934.

Coal-cutters, essential for working straight faces, 15692, 15851, 15923.
Dust arising from careless use of coal-cutters, 15694.

Coal Mines Regulation Act:
Adequacy of, if strictly observed, 15891, 15896.
Importance of strict observance of, 15902.

Doors, arrest of explosion by, views as to whether possible and suggestions as to experiments, 15931.

Durham: Electric safety lamps, use of, in, 15770.

Dust in Mines:
Experiments, *see that title.*
Explosions:
Altofts Colliery, *see that title.*
Amount of dust required to carry on an explosion, 15649.
Causes of, 15836, 15896, 15898.
Pressure exercised by, 15670, 15904.
Prevention or removal of:
Haulage in relation to prevention, 15677, 15695.
Screening-plant, dust from, prevention from going down pit, 15678, 15824.
Straight faces, working with, decrease in amount of dust resulting, *see title* Altofts Colliery, *sub-heading* Method of working.
Vacuum cleaner, experiments with, advocated, 15881.
Wagons, dust-tight, *see title* Wagons.
Watering, *see that title.*
Zones, dry, dustless:
Absolute cleansing impracticable, 15877.
Experiments as to, advocated, 15876.
Position advocated for, 15634, 15899.
Sources of dust enumerated, 15693, 15695.

Experiments, suggestions as to:
Doors for arresting explosions, 15931.
Dust, experiments as to, suggestions as to:
Amount that would cause or carry on explosion, 15649, 15876.
Causes of explosions, 15836, 15898, 15902.
List of experiments advocated by Witness, 15696.
Zones, effect of, 15696, 15904.
Rescue work, "Weg" life-saving apparatus, experiment with, 15791, 15798, 15803.
Safety lamps, velocity of intake current putting out lights, experiment at Aldwarke Main as to, 15767.
Shot-firing: interval to elapse between firing of shots, 15833.

Explosions:
Altofts Colliery, *see that title.*
Doors, arrest by, views as to whether possible, 15931.
(*See also title* Dust, *sub-heading* Explosions.)

Explosives, Permitted, regulations as to in Altofts Collieries, 15670.

Fowler, Mr., evidence of, reference to, 15878, 15880.

France: Electric lamps in mines, arrangement with electric light company as to provision and maintenance of, 15750.

Germany: Rescue apparatus used in, 15798, 15799, 15817.

Haulage with reference to dust:
Endless chain system, dust caused by, 15695.
Measures suggested for prevention of dust, 15677.

Lancashire, electric safety lamps used in, 15769.

Digitized by Google

GARFORTH, Mr. W. E.—*cont.*
Miners' Nystagmus, effect of use of safety lamps on, 15719, 15727, 15747, 15757.
Qualifications of Witness, 15618, 15821.
Rescue Work and Appliances :
Altofts Gallery, 15792.
"Weg" life-saving apparatus, 15617A.
Description of, 15791 *et seq.*
Electric lamp carried by man wearing, 15728, 15818.
Standardising of valve advocated, 15802.
Training in use of, necessary, 15805.
Weight, 15795, 15802, 15814.
Work that can be done by man wearing, 15799, 15802.
Royal Commission on Coal Dust, evidence before, as to Altofts Colliery explosion, 15644.
Safety Lamps :
Candle-power of, 15699.
Defects of, 15700, 15767.
Electric lamps :
Advantages and disadvantages of, 15726, 15730.
Batteries, improvement in, 15770.
Collieries using, 15769.
France, arrangement in, with electric light company as to provision and maintenance. 15750.
Indications of gas not given by, 15738.
Lieving apparatus for testing condition of atmosphere, 15740, 15786.
"Weg" life-saving apparatus, electric lamp carried by man wearing, 15728, 15818.
Indications furnished by, as to presence of gas, 15723, 15739.
Miners' Nystagmus, number of men suffering from, comparison of men using safety lamps and men using naked lights, 15719.
Electric lights, use of, would probably put an end to this disease, 15727, 15747.
Serious character of this disease, 15757.
Re-lighting safety lamps, 15710, 15766.
Testing station advocated, 15756.
Two lamps supplied to majority of men in Altofts Colliery, 15711, 15758.
Shot-firing :
Acts of Parliament, regulations, &c. :
Adequacy of, if strictly observed, 15830, 15885.
General Rule 12, extent of watering required by, 15670.
Examination between each shot for detection of dust in suspension, advisability of, 15838.
Instance proving, 15840.
Explosions, number caused by, views as to, 15894.
Notice to manager and permission from him before shot is fired in haulage road, views as to, 15841.
Official appointed for, at Altofts Collieries, 15844.
Permitted explosives, use of, in Altofts Collieries, 15830.
Time to elapse between firing of shots, 15674, 15833.
Watering in neighbourhood of a shot, practice as to, in Altofts Collieries, 15670.
Timbering System, Altofts Collieries, 15684, 15689, 15776, 15781.
Plate illustrating, 15692.
Wagons :
Dust from, 15695.
Dust-tight types advocated, &c., 15674, 15824.
Danger of iron tubs in steep mines, 15676.
Watering :
Compulsory, objections to, 15869, 15927.
Dangers and difficulties of :
Effect of, on roof and sides, in Altofts Collieries, 15671, 15685, 15859.
Photographs and specimens of stone showing, 15673, 15859.
Health of miners, effect on, 15874.
Impossibility of watering in some mines in Altofts Collieries, 15864, 15872, 15900.
Extent of, in Altofts Collieries, 15686.
Zones, watered :
Arching, difficulty as to, 15866.
Arrest of explosion by, possibility of, and instance of in Altofts explosion, 15637, 15645, 15656, 15660, 15906.
Compulsion as to, inadvisable, 15870, 15927.
Experiments as to, advocated, 15696, 15904.

GARFORTH, Mr. W. E.—*cont.*
Yorkshire :
Altofts Collieries, *see that title.*
Safety lamps, electric, use of in, 15769.
Zones, *see title* Dust, *sub-heading* Prevention, and *title* Watering, *sub-heading* Zones.

HABERSHON, Mr. M. H., Mining Engineer to Messrs. Newton Chambers and Company's Collieries, Thorncliffe, near Sheffield. *(See questions* 18914A-19095*).*
Altofts Colliery, Mr. Garforth's experimental station at, 18914A (*par.* 7).
Tests held at, 18914A (*par.* 8), 18924, 19061.
Breathing Apparatus :
Comparative merits of different kinds, summary of, 18943, 19077, 19086.
Danger of use of, unless apparatus is in perfect order and in hands of properly trained men, 18914A (*par.* 12), 18945, 18946.
Draeger apparatus, *see that title.*
Hunger induced by wearing, 18914A (*par.* 10).
Medical examination of men before training advocated, 19043.
Paper on, by Witness, 18914A (*pars* 3 and 5).
Pneumatogen, *see that title.*
Responsibility for, 18953, 18966, 18972.
Rust, danger of, and method of prevention, 18940.
Stations, central, suggestions as to, *see title* Station.
Testing before use, importance of, 18949, 18958, 18980, 19009, 19036.
Training of men in use of, suggestion as to, 18914A (*par.* 13), 18949, 18968, 18980, 19016, 19030, 19054.
Cost of, 19030.
Length of training, 19033, 19043.
"Weg" apparatus, *see that title.*
Courrieres Mine Disaster, death of man wearing breathing apparatus, 19018, 19091.
"Draeger" Breathing Apparatus :
Comparative merits, summary of, 18943
Distinction between Draeger and Weg apparatus as regards oxygen feeding, 19077, 19086.
Filling by means of high-pressure pumps, 18941.
Hunger induced by use of, 18932.
Mouth-breathing and helmet-breathing systems described, 19075.
Removal by man himself, possibility of, 19090.
Temperature of mine, effect of on, question as to, 19093.
Tests :
Breakdown during tests, instance of, 18924, 18929.
Duration tests, 18914A (*par.* 10), 18931, 19074.
Work done by man wearing apparatus, 18914A (*pars.* 8, 10 and 11), 18924, 18933, 19061.
Training men in use of :
Cost of, 19030.
Length of training, 19033, 19043.
Weight of, 19059, 19088.
Westphalia, adoption in, at Gelsenkirchen, 18937.
"Fleuss" Apparatus, Witness has had no experience with, 19071.
Germany, Rescue Work and Appliances in :
Attitude of Government towards, 18914A (*par.* 16), 18985.
Draeger apparatus, adoption at Gelsenkirchen, 18937.
Giersburg apparatus, 18914A (*par.* 3).
Shamrock Colliery, apparatus at, 18914A (*par.* 3), 18919, 18939, 19070.
Giersburg Apparatus, 18914A (*par.* 3), 18919.
Grey, Mr., evidence of, reference to, 18989.
Pneumatogen :
Cost of, 19006.
Heat given off by, 19004.
Vomiting resulting from use of, 19001.
Weight of, and work that can be undertaken by man wearing, 18989.
Qualifications of Witness, 18914A, 18915.
"Shamrock" Apparatus, 18914A (*par.* 3), 18919.
Headache caused by use of, 19070.
New type of apparatus, 18939, 18940.

Digitized by Google

HABERSHON, Mr. M. H.—*cont.*

Station, Central, for groups of collieries, at which apparatus could be kept and men trained, suggestions as to, 18914A (*par.* 13), 18948, 18953, 18968, 18977, 19054, 19064.
Cost of, 19030, 19049.
Method of defraying, 19023.
Distance from collieries need not be a disadvantage, 18955, 18968.
Gallery necessary for training men, 19047.
Inspection by H.M. Inspector of Mines advocated, 18914A (*par.* 17), 19013.
Midland Institute of Mining Engineers, establishment of stations considered by, 18914A (*par* 2).
Model station, tracing of, and estimate of cost of, 19049.
Number of men required at, 19021.
Number of sets of breathing apparatus to be kept at, 19019.
Papers on, by Witness, 18914A (*pars.* 2, 3 and 5), 18917.
Plate showing suggested design, 19049.
Position of, views as to, 19023.
Postponement of provision until Report of this Commission, probability of, 18914A (*par.* 11).
Responsibility for, 19031.
Scheme of working described in detail, 18969, 18980, 19009, 19066.
Tankersley Rescue Station, *see that title.*

Tankersley Rescue Station, 18914A (*pars.* 1 and 4).
Apparatus used at, 18914A (*pars.* 3 and 9), 18919
Cost of working, 19030.
Method of defraying, 19023.
Plan of, 19046.
Scheme of working described, 19023.
Sole joint colliery rescue station in England, 18914A (*par.* 16), 18921.
Tests at, record of, 18914A (*par.* 9)
Training of men at, 18914A (*par.* 4).

"Weg" Apparatus:
Distinction from "Draeger" apparatus as regards oxygen feeding, 19077, 19086.
Still in course of development, 18937, 18943, 19062.
Tests:
Breakdown during, 18924, 18929.
Duration tests, 19074.
Work done by men wearing apparatus, 18914A (*par.* 8), 18924.
Weight of, 19059, 19088.

HANNAH, Mr. D., Mining Engineer and Agent to Messrs. D. Davis & Sons, Ltd. (*Monmouthshire and South Wales Coal Owners' Association.*) (*See questions* 19095A—19620).

Abertysswg Colliery Explosion, cause of, 19574.

Accidents:
Falls of roof and sides, 19545, 19561.
Dry seams, falls in, 19568.
Haulage accidents, 19095A (*par.* 15), 19260.

Coal-cutting Machinery:
Dust made by, fineness and inflammability of 19095A (*par.* 7), 19176, 19397, 19456.
Electrically-driven, danger of, 19608.
Ferndale Colliery, experiments with, 19176, 19390.
Success at present doubtful, 19187.
Method of bringing down coal after it is cut, 19461.
"Pickwick" Machine, 19177.
Shot-firing unnecessary with, 19463, 19595.

Dust in Mines:
Analysis of dust, Ferndale Collieries, 19095A (*par.* 16), 19268, 19305, 19579.
Coal-cutting machinery, dust produced by, fineness of, 19095A (*par.* 7), 19177, 19396, 19456.
Definition of a dusty mine, difficulty of, 19095A (*par.* 1), 19100.
Engine-planes:
Inflammability of dust in, 19095A (*par.* 8), 19109.
Smooth running, importance of, 19152.
Explosions, cause of, 19095A (*par.* 4), 19121.
Amount of dust sufficient to cause an explosion, 19101.
Small amount more dangerous than large, views on this point, 19102.
Face, small danger of explosion in, 19132.

HANNAH, Mr. D.—*cont.*

Dust in Mines—*cont.*
Inflammability of various kinds of coal dust, 19095A (*pars.* 2, 6, 7 and 8), 19108, 19131, 19168.
Fine dust most explosive, 19131.
Prevention or removal of:
Brushing away:
Absolute freedom from dust, impossibility of securing by, 19095A (*par.* 12), 19225.
Extent to which practised in Ferndale Collieries, 19401, 19486, 19488, 19538, 19539.
Mixing of non-inflammable matter with dust in horse haulage roads, effect of, in rendering dust less explosive, 19112, 19115.
Screening-plant, dust from, going down downcast shaft, 19095A (*par.* 7), 19164.
Distance of screens from pit, 19157.
Removal of screens, impracticability of, 19095A (*par.* 7)
Watering (spraying) at top of shaft, 19095A (*par.* 7), 19160, 19196, 19450.
Systematic removal not practised in South Wales, 19401, 19486.
Roadways (horse haulage roads), inflammability of dust in, 19095A (*par.* 8), 19112, 19115.
Ventilation, increase of dust by, 19400.

Electric Coal-cutting Machinery, danger of, 19608.

Electricity Rules, amendment of, unnecessary, 19387.

Engine-Planes, dust in:
Inflammability of, 19095A (*par.* 8), 19109.
Smooth running, importance of, 19152.

Explosions:
Cause of, 19095A (*par.* 3), 19120.
Spark caused by falling stones causing an explosion, Report by Mr. Robson on, 19555.
Dust, *see that title.*
Intensification of, by coal dust or strong current of fresh air, 19095A (*par.* 5), 19129.
Occurrence of, when no men were in pit, instance of, 19555.

Explosives, supply of, by owners to men, Ferndale Collieries, 19383.

Explosives Order: Regulation as to inspection of place in case of miss-fire shot, 19347.

Haulage Accidents, danger of, increased by watering in steep inclines, 19095A (*par.* 15), 19260.

Ocean Collieries, explosion at, when no men were in pit, 19557.

Qualifications of Witness, 19095A, 19096.

Rescue Work: Breathing apparatus, Witness has no experience of, 19412.

Safety Lamps, locked, use of, in Ferndale Collieries, 19389.

Shot-firing:
Acts, Orders, Regulations, &c., adequacy of, if strictly observed, 19559.
Accidents due to, 19216.
Between shifts, Ferndale Collieries, 19332.
Blown-out shots, 19369, 19373.
Charging of hole, special man employed for, in Ferndale Collieries, and views as to whether General Rule as to is desirable, 19436.
Coal-cutting machinery, shot-firing unnecessary when used, 19463, 19595.
Detonators, testing of, Ferndale Collieries, 19344, 19414.
Drilling holes, by colliers themselves, 19332, 19356.
Appointment of special men for, views as to, 19435.
Instruction, special, not given to men, 19358.
Special Rule unnecessary, 19362, 19371.
Electrically-fired shots, 19342, 19387.
Evidence of Witness as to, given specially with regard to Ferndale Collieries, 19434.
Face, shot-firing at, system adopted in Ferndale Collieries, 19329, 19340.
Miss-fire shots:
Interval before another shot is fired, 19343.
Rarity of, in Ferndale Collieries, 19343, 19414.
Record of, by firemen, 19420.

Digitized by Google

HANNAH, Mr. D.—*cont.*
Shot-firing—*cont.*
Notice to manager and permission from him before shot is fired in main haulage roads, 19336.
Number of shots to be fired simultaneously in main haulage roads: limitation to one advocated, 19346, 19349.
Officials or men, shot-firing by:
Special men, appointment of, 19332, 19377, 19380.
Charging hole, appointment for, views as to, 19560.
Instruction to, method of, 19376.
Stemming, appointment for, views as to, 19616.
Witness knows of no instance of, 19618.
Record kept by firemen, 19420.
Roadways (main haulage), regulations as to, in Ferndale Collieries, 19336.
Solid, shot-firing in, danger of, 19619.
Stemming, regulations as to, 19370.
Watering in neighbourhood of a shot:
Area of, extension unnecessary, 19213, 19355.
Strict observance of rules as to, would make examination for dust unnecessary, 19353.

Treharris, explosion at, when no men were in pit, 19557.

Tylorstown, disaster at, owing to shot-firing, 19216.

Wagons:
Amount of coal held by, 19582.
Proportion of small coal, 19583.
Dust from, inflammability of, 19095A (*par.* 6), 19134, 19141.
Dust-tight, type of wagon used, &c., 19095A (*par.* 7), 19141, 19477.
Watering of coal in, 19135.
Extent required, and extent to which practised in Ferndale Collieries, 19586, 19589.
Damage to coal, question as to, 19136.
Screening not affected in Ferndale Collieries, 19542.
Objections of workmen to, improbable, 19592.

Watering, 19095A (*pars.* 9, 10 and 16), 19201.
Cost of, in Ferndale Collieries, and estimate of cost of thorough watering, 19095A (*pars.* 14, 15 and 16), 19240, 19270, 19408, 19428, 19493, 19510, 19512.
Danger and difficulty of:
Breakage of pipes by falls of stone, 19319, 19611.
Damage to coal, none in Ferndale Collieries, 19449.
Effect on roof and sides and floor, 19095A (*par.* 15), 19249, 19300, 19403, 19495, 19545, 19553.
Accident in Ferndale Colliery, 19545, 19561.
Time at which repairs to roof and sides are made, 19409.
Haulage accidents, probable increase, 19095A (*par.* 15), 19260.
Paving of floor, 19095A (*par.* 15), 19257.
Ventilation possibly affected by, 19405.
Extent advocated:
Complete watering preferable to zones, where possible, 19095A (*par.* 15), 19222.
Ferndale Collieries, extent in, 19538.
Floor only, watering of, views as to, 19197.
Face, watering near, in South Wales mines, 19191.
Hose and man system, 19095A (*par.* 10), 19205.
Pipe system, 19095A (*par.* 14), 19201, 19319, 19505.
Inspection of pipes, 19326.
Length of roadways watered, Ferndale Collieries, 19095A (*par.* 16), 19241, 19267.
Extent unwatered, 19288, 19293, 19315.
Plans showing all water pipes on main haulage roads, Ferndale Collieries, 19312.
Size of pipes, 19316.
Return as to systems in Glamorganshire mines, 19201.
Spray system, 19095A (*par.* 10), 19203.
Tank and cask system, 19095A (*par.* 10), 19210.
Time at which watering is done, Ferndale Colliery, 19612.

HANNAH, Mr. D.—*cont.*
Watering—*cont.*
Zones, suggestion as to, 19095A (*par.* 11), 19224.
Advantages of wet as compared with dry zones, 19256.
Arching, 19095A (*par.* 11).
Possibility of, in mines in South Wales, 19220.
Compulsory provision, views as to this suggestion, 19298.
Cost of, estimate of, 19243.
Length of, views as to, 19095A (*par.* 11).
Spray system advocated for, 19219.

Ystrad Explosion, absence of men from pit at time of, 19558.

Zones, *see title* Watering, *sub-heading* Zones.

HENSHAW, Mr. A. M., Director and General Manager of Talk-o'-th-Hill Colliery, Stoke-on-Trent. (*North Staffordshire Coal Owners' Association.*) (*See questions* 10545–10996.)

Accidents:
Face of mine and roadways, number of accidents in compared, 10777.
Falls of roof and sides, 10546 (*par.* 55).
Number of and death-rate from, as compared with number of explosions, 10546 (*pars.* 28 and 55), 10585.

Albion Colliery Explosion, probable number of deaths if explosion had occurred during day shift, 10952.

Ankylostomiasis, possible effect of watering on, 10546 (*par.* 31).

Belgium:
Experimental Gallery at Frameries, 10546 (*par.* 73), 10968.
Watering in deep mines, 10546 (*par.* 30).

Coal-cutting Machinery, dust produced by, 10546 (*par.* 21), 10578, 10757, 10765, 10780.
Use of machines chiefly confined to small veins of stone or shale, 10896.

Coal-Tax, utilisation of money from to defray cost of galleries for experiments with dust, suggestion as to, 10962.

Courrières Mine, Explosion:
Arrest of explosion, 10546 (*par.* 16), 10560, 10801.
Plan illustrating, 10560.
Course traversed by explosion, plate illustrating, 10546 (*par.* 16).
Dust, analysis, 10546 (*par.* 16 and 73), 10556, 10717, 10721, 10798, 10801, 10803.
Samples of dust, 10546 (*page* 14, *col.* 2), 10803.
Powder used for blasting, 10868.
Similar accident, views as to whether possible or probable in this country, 10815, 10948.
Underground communication, extent of, 10815, 10818, 10820, 10954.

Depth of mines in relation to watering, 10546 (*par.* 30).

Dust in Mines:
Causes, chief, of, 10546 (*par.* 19 *et seq.*, 34 *et seq.*).
Class of coal producing most dust, 10546 (*par.* 19), 10910.
Classification of dusty mines, difficulty of, 10798.
Coal-cutting machinery, dust produced by, 10546 (*par.* 21), 10578, 10757, 10765, 10780.
Experiments, *see that title.*
Explosions in relation to dust:
Brancepeth, 10549, 10723.
Cause of, 10546 (*par.* 1 *et seq.*), 10547.
Number of, and of deaths from, 10744.
Face:
Amount of dust produced at, 10546 (*pars.* 22 and 38), 10755.
Explosions traversing, rarity of, 10546 (*par.* 25), 10582, 10749.
Removal of dust from, impossibility of, 10546 (*par.* 23 *et seq.*), 10579.
Haulage in relation to: advantages of endless rope system, 10546 (*par.* 39 *et seq.*), 10591, 10726, 10903.
Inflammability of various kinds of dust, 10546 (*par.* 10 *et seq.*), 10556, 10798.
Methods of work in relation to production of dust, 10546 (*par* 20), 10577.

Digitized by Google

HENSHAW, Mr. A. M.—*cont.*

Dust in Mines—*cont.*
Prevention or removal of by other methods than watering:
Adequate removal, difficulty of, 10546 (*par.* 49), 10851, 10838, 10854.
Arching of brick, 10841:
Squeeze, effect of, on, 10890.
Brushing away, 10546 (*pars.* 52 and 53), 10611.
Calcium chloride or magnesium chloride, 10984.
Chloride of sodium, 10982.
Fans and pipes, 10546 (*par.* 46), 10595.
Increased attention to advocated, 10546 (*par.* 6 *et seq.*), 10551.
Jets of compressed air, 10546 (*par.* 65),10683, 10852.
Mixing of non-inflammable substances with dust, explosion arrested by, 10798, 10808.
Roadways, 10546 (*par.* 50 *et seq.*), 10584, 10599, 10611.
Salt, sprinkling, 10546 (*par.* 66), 10679, 10980.
Screening-plant, dust from going down downcast shaft, 10546 (*par.* 46), 10595, 10879.
Fans and pipes for exhaustion of, 10595.
Natural moisture, saturation by, 10879.
Sprays in downcast shaft, 10596.
Stricter observance of existing rules would prevent many accidents, 10546 (*par.* 70).
Wagons, dust from, *see title* Wagons.
Whitewashing, 10546 (*par.* 53), 10611.
Roadways in which most prevalent, 10546 (*par.* 35 *et seq.*), 10584, 10594.

Experiments:
Hall, Mr., experiments by, 10546 (*par.* 7), 10719.
Suggestions as to stations for, 10546 (*par.* 73), 10717, 10798, 10959.

Explosives:
Careless use of, explosions caused by, 10546 (*par.* 70), 10547.
Permitted explosives, advantage of; but tests should be more severe, 10546 (*par.* 71), 10866.
Flames given off by permitted explosives, instance of, 10867.
Government testing station, provision advocated, 10546 (*pars.* 71 and 73), 10867.

Explosives Order, ambiguity of, and neglect of Rule as regards watering in neighbourhood of a shot, 10546 (*par.* 71), 10689, 10701.
Strengthening of Order advocated, 10702.

Galloway, Professor, evidence of, reference to, 10613, 10617, 10734, 10851, 10885.

Germany, Watering in:
Rule as to, 10830.
Stand-pipe and hose system, 10671.
Thorough system, 10659.
Westphalia:
Experimental gallery, 10968.
Watering: Estimate of cost of similar system in England, 10624, 10629.

Gerrard, Mr., evidence of, reference to, 10546 (*par.* 46), 10595.

Rescue Work:
Official station, which might also be testing station for explosives, advocated, 10546 (*par.* 73).

Royal Commission on Coal Dust, 1894:
Flames igniting coal dust, instance of, 10549.
Testing coal dust, 10718.

Safety Lamps:
Explosion caused by defective lamps, 10546 (*pars.* 5, 26 and 72), 10547, 10712, 10716.
Gauzes, single, prohibition advocated, 10546 (*par.* 72), 10713.
Testing, official, of lamps and types of lamps advocated, 10546 (*par.* 72), 10713, 10990.

Shot-firing:
Abolition of, impossibility of, 10864.
Acts, Rules and Orders regulating:
Complexity and ambiguity of, 10546 (*par.*71), 10689.
French Rules, comparison with, 10957.
Strengthening advocated, 10546 (*par.* 71).
Stricter observance of would decrease number of explosions, 10546 (*pars.* 26, 70 and 71), 10751, 10755, 10882.

HENSHAW, Mr. A. M.—*cont.*

Shot-firing—*cont.*
Between shifts, advocated, in main roads, 10698, 10702.
Face, shot-firing in: danger arises chiefly from firedamp, 10763, 10859.
Number of explosions caused by, 10546 (*par.* 70), 10712.
Permission of manager and under-manager should be required in any case, 10706.
Qualification of person firing shots, suggestions as to, 10709.
Test of explosives, greater severity advocated, 10546 (*par.* 71).
Watering in neighbourhood of a shot:
Acts of Parliament, Orders & Rules, complex nature of, 10546 (*par.* 71), 10689, 10696, 10700.
Zone to be watered, 10700.
Weight of charge, limitation advocated, 10546 (*par.* 71), 10704.

Small Coal:
Gobbing, danger of, 10760, 10786.

Staffordshire:
Cost entailed in event of thorough watering of mines in North Staffordshire, estimate of, 10939.
Naturally wet condition of mine and its effect on roof and sides, 10940.

Talk-o'-th'-Hill Colliery Explosion: Explosion, arrest of by non-inflammable dust and wet zone, 10546 (*par.* 17).
Analysis of dust, 10546 (*par.* 17), 10556, 10798, 10808.
Plate illustrating, 10574.

Underground Intercommunication, danger of, when too extensive, illustrated by Courrières disaster, 10954.

Wagons:
Dust from, 10546 (*par.* 34), 10586.
Dust-tight:
Advantages of, 10546 (*par.* 50), 10604.
Compulsory use of, views as to, 10783.
Loading above top,unobjectionable if with large coal, 10587, 10611, 10846A, 10908.
Springs, unnecessary and impracticable, 10590, 10885.
Steel and wood with iron ends, advocated, 10546 (*par.* 50), 10607, 10731.
Sketch of, 10607.

Wales: Underground intercommunication, danger of, 10956.

Walker, Mr., evidence of, reference to, 10546 (*par.* 46), 10595.

Watering:
Ankylostomiasis would probably result from watering at the face, 10546 (*par.* 31).
Compulsory watering or General Rule as to watering, views as to, 10546 (*par.* 28), 10611, 10830, 10874, 10917, 10925, 10939.
Cost of:
Thorough watering, estimate of cost, 10618, 10624, 10741, 10917, 10925.
North Staffordshire, Witness is speaking chiefly with reference to, 10939.
Zone system, cost of, estimate of, 10640.
Difficulties and danger of, 10546 (*par.* 28), 10618, 10877.
Effect on roof and sides, 10546 (*par.* 28), 10611, 10878, 10914, 10944.
Extent required:
Floor only, views as to inadequacy of, 10612, 10734.
Slightly damp surface, arrest of explosion by, instance of, 10617.
Thorough watering, views as to, 10613, 10635.
Cost of, in all roadways, estimate of, 10618, 10624, 10741.
Zone watering, *see that sub-heading.*
Face, watering at, 10546 (*par.* 28), 10581, 10585, 10759.
Hose and stand-pipe system, 10546 (*pars.* 66 and 68), 10671, 10673.
Jets of water with compressed air, 10546 (*par.* 65), 10668, 10737.
Attitude of workmen as to, 10670.
Sketch of a jet, 10668.

Digitized by Google

HENSHAW, Mr. A. M.—*cont.*

Watering—*cont.*
Qualifications of man in charge of watering, 10673.
Spray system, 10546 (*par.* 66), 10668.
Zone Watering:
Advantages of, 10546 (*pars.* 18, 33 and 58), 10614, 10638, 10873.
After-damp, limitation of, 10648.
Arrest of explosions by, instance of, 10546, (*par.* 18), 10560, 10574.
Arching of zones, 10546 (*par.* 60), 10643, 10661, 10886.
Squeeze, effect of on, 10890.
Brine, experiment with, 10980, 10987.
Cost of, estimate of, 10640.
Compulsion as to, advocated for dry and dusty mines, 10657, 10662, 10831, 10857.
Exemption of airways and travelling roads, views as to, and as to arbitration in cases of dispute, 10663.
Extent to which life would probably be saved by, 10649.
Face, zone watering in, necessary under certain conditions, 10759.
Frequency with which zone should be watered, 10974.
Length of zone required, 10546 (*pars.* 18 and 61), 10559, 10932.
Pipes or tanks, watering by, 10972.
Plan illustrating, 10546 (*par.* 58), 10638.
Position of wet zones, 10546 (*par.* 59).
Steel props advocated, 10843.
Preparation of roads, 10546 (*par.* 60), 10645, 10661, 10837, 10844.

Westphalia, *see title* Germany.

Woolwich, experimental gallery at, 10872, 10968, 10994.

Zones, *see title* Watering, *sub-heading* Zones.

HODGES, Mr. ISAAC, General Manager and Engineer for Henry Briggs & Co., Ltd., Whitwood Collieries, Normanton; (*National Association of Colliery Managers*). (*See questions* 11837A—12136.

Belgium, deep mines in, 12068.

Blackwell Colliery, Explosion at:
Arched dustless zone, arrest of explosion by, 11837A (*par.* 8), 11848, 11902, 12084, 12111.
After-damp, arrest of, 12085.
Dampness of zone, insufficient to influence arrest of explosion, 12111.
Length of zone, 11905, 12084.
Plates illustrating, 11902.
Position of zone, plan showing, 11902, 12133.
Purpose for which zone was arched—not specially to arrest explosion, 12089.
Cages not injured, 11944.
Cause of explosion:
Dust in old packs and crevices, 11953, 12020.
Manner in which shot was fired, 12129.
Course traversed by explosion, 11902, 11981, 12121.
Dust:
Cause of explosion, 11953, 12020, 12129.
Character of dust, 11848.
Experiments previously to explosion, inability to procure an explosion from, 12038, 12087.
Gas, absence of, 12040.
Poisoning by gas, death from, 11982, 12121.
Stokes, Mr., Report on and evidence as to, 11919, 11940, 11944.

Coal-cutting Machinery, increase in shot-firing since introduction of, 11963, 12106.

Deep Mines:
Arched zone of brickwork, impracticability of in, 12061, 12128.
Coal in the future will come largely from, upper mains being rapidly exhausted, 12069.
Watering, difficulty and danger of in, 12064, 12127.
Whitwood Colliery, depth of deepest seam, 12128.

Doors to arrest explosions, views as to whether practicable, 11898.

Dust in Mines:
Amount of dust in different seams, variations in, 12036.
Classification of mines as dusty or non-dusty, impossibility of, 11837A (*par.* 1), 11842.

HODGES, Mr. I.—*cont.*

Dust in Mines—*cont.*
Explosions in relation to:
Absence of gas, possibility of, 12039.
Amount of dust required to cause an explosion, 11859.
Blackwell explosion, *see that title.*
Causes of dust explosions, 11837A (*par.* 2), 11844, 11855, 12020.
Character of dust in relation to arrest of explosion, 11848.
Inflammability of various kinds of dust, 11837A, (*pars.* 3 and 4), 11842, 11844, 11846, 12038.
Experiments as to, required, 12053.
Prevention or removal by other methods than watering, views as to:
Brine, sprinkling with, 11837A (*par.* 10) 11958.
Screening plant, dust from, 11837A (*par.* 3).
Amount of dust, 12041.
Method of collecting, 12044.
Fan, exhaustion by, 12046.
Raising sides and enclosing top of shaft, question as to, 12047.
Removal of screening-plant to distance from shaft, or provision of a special building, views as to, 11837A (*par.* 5), 11948, 12045.
Vacuum cleanser, unsatisfactory working of, 11837A (*par.* 8).
Watering, *see that title.*
Zones, dustless:
After-damp, arrest by, improbable, 12002.
Arrest of explosions by, 12120.
(*See also* Blackwell Colliery Explosion.)
Brine, sprinkling with, 11837A (*par.* 10), 11958.
Concrete roof, with side walls or girders, 11950.
Deep mines, difficulty of provision in; exemption of such mines advocated, 12061, 12128.
Dry as compared with watered zones, efficiency of 12031.
Frequency with which cleaned, 11946.
General Rule as to, question as to whether desirable, 12053, 12062.
Watering dust to lay it before filling tubs, 11849.
Whitwood Colliery, practice as to, 11837A (*par.* 6), 11898, 12053.
Cost, 12029.
Number of zones, 12029.
Position of zones, 12026, 12029A.
Sheets to prevent dust travelling into mine, 11896.
Wagons, dust in, *see title* Wagons.
Watering, *see that title.*

Experiments as to inflammability of various dusts, necessity for, 12053.

Explosions:
Blackwell Colliery, *see that title.*
Causes, chief of, 12100.
Doors to arrest explosion, views as to whether practicable, 11899.
Dust in relation to, *see title* Dust.
Face of mine, safety of, as compared with roadways, 11997, 12004, 12018.
Instruction of men as to safest course to pursue in event of, 12004, 12005.
Number of, reductions in, 12099.
Poisonous gas:
Absence of, in dust explosions, possibility of, 12039.
Death from poisonous gas, instance of, 11982, 12121.
Frequency of, 11998.
Telephone as a means of communication, question as to, 12007, 12014.

Explosives, Permitted, use of, in Whitwood Colliery, 11973.

Midland District: Doors to arrest explosion, provision of, 11901.

Qualifications of Witness, 11838.

Digitized by Google

HODGES, Mr. I.—*cont.*

Shot-firing :
Between shifts, 11978, 11980.
Prohibition of shot-firing except between shifts, difficulty and danger of, 11837A (*par.* 11), 11961.
Explosions in relation to, 11837A (*par.* 11), 11858, 11975, 12104.
Face, shot-firing at, in Whitwood Colliery, 12092.
Increase in practice of, especially since introduction of coal-cutting machinery, 11963, 12105.
Notice to and permission from manager, before firing shot in main haulage road, advocated, 11837A (*par.* 11), 11976, 12080.
Practice as to, in Whitwood Colliery, 12092.
Watering in neighbourhood of a shot, necessity for, and for strict observance of Rule 12, 11966, 11977.
Complete clearing away of dust, difficulty of, 12020, 12021.

Stokes, Mr., evidence of, reference to, 11919.

Telephones in mines, 12007 :
Cost of, question as to, 12011.
Effect of explosions on, question as to, 12008, 12014.
Underground communication, Whitwood Colliery, (*par.* 8).

Vacuum Cleanser, air-pump on principle of, working of, 11837A (*par.* 15, *col.* 2), 11949, 12059.

Wagons, dust from, 11837A (*par.* 4).
Dust-tight wagons, advantages of, 11837A (*par.* 5), 11864, 11886.
Steel wagons, introduction abandoned in Whitwood Colliery owing to objections of workmen, 11837A (*par.* 5), 11871.
Whitwood Silkstone Colliery, type used at, 11837A (*par.* 5), 11871, 12049.
Cost of, 11881.
Sketch of, 11874.
Flaps, wagons with, unsatisfactory working of, 11875.
Loading wagons above sides, General Rule as to, would be difficult to enforce, 11865.
Watering wagons, objection to, injury to coal, &c., 11837A (*par.* 5), 11884.

Walker, Mr., evidence of, reference to, 11837A (*par.* 5).

Watering :
Brushing away of dust, watering in conjunction with, Whitwood Colliery, 11894.
Compulsory watering or General Rule as to watering, objections to, 11837A (*par.* 6), 11887, 12099.
Cost of effective watering, 11837A (*par.* 9).
Dangers and difficulty of, 12099, 12127.
Effect on roof, sides and floor, 11837A (*pars.* 6 and 9), 11889, 12033, 12125.
Health of miners, effect on, 11837A (*par.* 9), 11955.
Deep mines, difficulty of watering in, 12064, 12127.
Extent necessary for adequate watering, 11837A (*par.* 6), 11887
Zone watering : position in which zone should be placed, 12026.

Yorkshire Coalfields :
Dust at working faces not explosive, 11837A (*par.* 3), 11858.
Shot-firing, extent of, 12106.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zone.

HOLLINGWORTH, Mr. GEORGE HENRY, Mining Engineer *(National Association of Colliery Managers.)* (*See questions* 11331A—11837.)

Accidents :
Falls of roof and sides, number of, 11358, 11613, 11795, 11810.
Proportion in wet and in dry mines, statistics as to have not been collected, 11360, 11365.
Watering, thorough, would probably increase number of, 11331A (*par.* 3), 11337, 11615

Cornish Mines, watering in, does not apparently affect health of miners, 11821.

Courrières Mine, Explosion in :
Character of the mine, whether dry or wet, question as to, 11793.
Dust tests, 11386, 11418, 11532.

HOLLINGWORTH, Mr. G. H.—*cont.*

Depth of Mines, watering in relation to ; impossibility of watering very deep mines, &c., 11822.

Discipline in Lancashire mines, 11468.

Dust in Mines :
Causes of, 11731.
Deep mines, dust in, 11714.
Explosions :
Amount of dust required to cause an explosion, 11511, 11576, 11756.
Face, dust less prevalent at, than in roadways, 11651.
Inflammability of various kinds of dust, 11386, 11394, 11418, 11641.
Experiments :
Hall, Mr., experiments by, 11644.
Importance of and suggestions as to, 11331A (*pars.* 7 and 8), 11386, 11422, 11560, 11648, 11833.
Prevention or removal of by other means than watering, 11331A (*par.* 5 *et seq.*), 11369, 11661, 11667.
Compulsion as to removal of dust, views as to whether desireable, 11728, 11801.
Face, removal from, Witness has made no experiments as to, 11659.
Mixing dust with non-inflammable substance views as to, 11389.
Roadways (haulage roads), freedom from dust, importance of, 11331A (*pars.* 10 and 11), 11375.
Screening plant, removal to distance from down-cast shaft advocated, 11331A (*par.* 11), 11744.
Standard of dryness or wetness, suggestions as to, 11331A (*par.* 7), 11432, 11808.
Zones (dry, dustless), views as to, 11331A (*pars.* 5 and 9), 11376, 11511, 11576, 11725.
Afterdamp would not be prevented by, 11680.
Amount of dust that might be left with safety, questions as to, 11511, 11576, 11756.
Arching of brick, 11627.
Arrest of explosion by, views as to, 11424, 11457.
Discretion of manager as to dry or wet zones, advocated, 11674.
Frequency with which zones must be swept 11667 11727, 11736, 11741.
Length of zone, 11425, 11676.
Watering of dust not practised by witness under this system, 11381.
Temperature in relation to, 11716, 11720.

Experiments :
Hall, Mr., experiments by, 11644.
Importance of, and suggestions as to, 11331A (*pars.* 7 and 8), 11386, 11422, 11560. 11648, 11833.
Lancashire, experimental pit in, 11835.

Explosions :
Causes of :
Amount of dust required to cause an explosion, 11511, 11576, 11756.
Experiments as to, advocated, 11331A (*pars.* 7 and 8), 11426.
Lancashire, small number of, in, 11331A (*par.* 3), 11466, 11468, 11601, 11603.
Manchester, small number of, in, 11371, 11602, 11758, 11768.
Natural causes, explosion from, without firing of shot and when no men were down pit, 11759.
South Wales, number of, in, 11468, 11770.

Explosives :
Bobbinite, 11569.
Lancashire, use of permitted explosives in, 11532.

Explosives Order :
Effect of as regards shot-firing regulations, 11571, 11639.

Germany, watering in mines in :
Cost of, 11486, 11776.
Damage caused by :
Decrease in with experience, 11812.
Extent of watering which would cause no damage, experience as to, 11815.

Digitized by Google

HOLLINGWORTH, Mr. G. H.—*cont.*

Scotland, extent to which safety lamps are used in, 11481.

Hall, Mr.:
Evidence of, reference to, 11571.
Experiments by, 11644.

Hibernia Colliery Company, watering, cost of, 11777.

Qualifications of Witness, 11332, 11341, 11748.

Safety Lamps, extent to which used in Lancashire and Scotland and South Wales, 11479, 11481.

Shot-firing:
Acts and Orders, regulating, strict observance of, importance of, 11331A (*par.* 6), 11385, 11468, 11571, 11639.
Between shifts, 11634.
Officials, blasting usually done by, 11539.
Prohibition of shot-firing except between shifts, views as to, 11416, 11520.
Difficulty as to, especially in the working face, 11520, 11521, 11533.
Gas in main haulage roads, question as to possibility of, 11579.
Number of men in mine during, limitation advocated, 11416.
Person firing shots, 11539, 11634, 11637.
Temperature of explosion of shot, effect of with regard to explosions, &c., 11331A (*par.* 7), 11426.
Vortex rings, explosion caused by, Witness has no knowledge of, 11428.
Watering in neighbourhood of a shot:
Acts, Orders and Rules, observance of, 11331A (*par.* 6), 11397, 11571.
Desirability of watering as an additional precaution in mines cleared of dust by other methods, 11446.
Extent of watering advocated, 11398, 11405 11452.
Haulage roads, shot-firing in, evidence of Witness given specially with reference to, 11573.
Spray, watering with advocated, 11403, 11414, 11451.

Timbering: Accidents from falls of roof and sides, 11613.

Wagons:
Dust from, 11331A (*par.* 10).
Dust-tight, advocated, 11331A (*par.* 11), 11458 11731, 11750.
Improvement in, advocated, 11331A (*par.* 11).
Loading above top, views as to, 11461, 11753.
Watering coal in, views as to, 11331A (*par.* 11), 11459, 11732.

Water, natural, in Mines:
Amount of, in a wet mine, 11497.
Channel in which water is made to flow, 11331A (*par.* 5), 11370, 11763.

Watering:
Compulsory thorough watering or General Rule as to watering, impracticability of, largely on account of cost, 11331A (*par.* 6), 11337, 11438, 11628, 11772.
Estimate of cost, 11486, 11596.
Exception to this rule, one mine only within knowledge of Witness, 1340, 111348.
Danger and difficulty of watering, 11331A (*par.* 2), 11337, 11485, 11588, 11688.
Effect on floor, 11331A (*par.* 2), 11348, 11360, 11589, 11790, 11815.
Effect on roof and sides, 11331A (*pars.* 2 and 3), 11340, 11347, 11354, 11455, 11505, 11790.
Examination by Witness of mine in which systematic watering is practised, question as to, 11811.
Extent of watering possible without damage to roads, 11815.
Health of men, effect on, 11331A (*par.* 4), 11367, 11508, 11818.
Strata which would not be affected by watering, 11790.
Depth of mines in relation to: impossibility of watering in very deep mines, 11688, 11822.
Experiments advocated, 11331A (*par.* 7), 11678.
Extent required, views as to, 11809, 11815.
(*See also sub-heading* Zone Watering.)
Standard of dryness, suggestion as to, 11331A (*par.* 7), 11432, 11451.

HOLLINGWORTH, Mr. G. H.—*cont.*

Watering—*cont.*
Witness has had no experience of artificial watering, 11623.
Zone watering:
Advantages of this system, 11454.
After-damp would not be prevented by, but amount would be reduced, 11680.
Cost of, with zones of 100 yards, 11780.
Decision as to should be left to managers, 11674.
Length of zone required, 11331A (*par.* 8), 11423, 11676, 11678.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zone.

HOOD, Mr. WILLIAM WALKER, Managing Director Glamorgan Coal Company, Ltd. (Llwynpia), &c. (*See questions* 13288A–13662.)

Barriers of Coal left under boundaries but not under railways, 13632.

Belgium:
Conchoidal fracture of coal in, 13288A (*par.* 2).
Watering in, physical conditions favourable to, 13567, 13570.

Blantyre Collieries:
Cutical fracture of coal in, 13620.
Explosion, cause of, 13622.

Clydach Vale:
Dust prevention: arching, 13322.
Explosion:
Cause of, dust above timbers, 13307, 13310, 13613.
Watered zone, failure to arrest explosion, 13302, 13347, 13353, 13378.

Dust:
Classification of mines as dusty and non-dusty, possibility of, 13288A (*par.* 1), 13367, 13370.
Explosions, dust as cause of, 13288A (*par.* 2), 13333, 13383.
Amount of dust required to cause an explosion, 13352.
Inflammability of various kinds of dust, 13288A (*pars.* 2 and 3), 13646.
Conchoidal fracture, dust from coal having, more explosive than from coal with cubical fracture, 13288A (*par.* 2), 13464.
Depth at which dust is dangerous, 13288A (*par.* 1), 13367, 13460.
Fine dust is most explosive, 13370, 13382, 13463.
Roadways: main haulage road, most inflammable dust in, 13288A (*par.* 3), 13473.
Timbers, dust above, most explosive, 13476.
Prevention or removal of, views as to:
Mixing of non-inflammable material with dust, 13288A (*par.* 7), 13475, 13510, 13645.
Glucose or sugar, questions as to, 13554.
Salt, sprinkling, 13288A (*par.* 7), 13510.
Sand-blast, questions as to practicability of, for removing dust above timbers, 13654.
Screening-plant, dust from going down downcast shaft, 13288A (*par.* 3), 13416.
Steam jets at top of downcast shaft, 13288A (*par.* 5), 13477.
Watering and brushing away combined, 13421.
Zones (dry, dustless), views as to:
Absolute freedom from dust, impossibility of securing by brushing away, 13392, 13507.
Advantages, superior, of wet as compared with dry zones, 13459.
Arching, 13322, 13347, 13423, 13456.
Depth of mine in relation to, 13425.
Pillars of coal, support by, suggestion as to, 13331.
Arrest of explosion by, possibility of, 13376.
Length required, absence of any evidence as to, 13377.
Shot-firing, prohibition of, in mines in which dustless zones are impracticable, views as to, 13431.

Digitized by Google

HOOD, Mr. W. W.—*cont.*

Dust—*cont.*
Roadways: main haulage roads, dust in, 13288A (*par.* 3), 13473.
Wagons, dust in, *see title* Wagons.

Experiments:
Inflammability of various kinds of dust, experiment as to, 13387.
Zones, dustless, length necessary to arrest explosions, experiments as to advocated, 13380.

Explosions:
Clydach Vale, *see that title.*
Dust in relation to, *see title* Dust.
Experience of Witness as to, 13294, 13300, 13452.
Face, safety of, as compared with other parts of mine, 13601.
Lamp glass, breaking of, by slight fall of roof, explosion caused by, 13333.
Shot-firing as cause of, 13391, 13467.

Explosives, Permitted, safety in use of, 13468.

France: Watering of mines, physical conditions favourable to, 13567.

Germany:
Hibernia Colliery, cubical fracture of coal in, 13569.
Watering:
Application of similar system to England, views as to, and as to necessity for exemptions, 13343, 13363, 13365.
Timbering, effect of, in, 13571.
Westphalian mines, watering, physical conditions favourable to, 13559.

Lamps: Explosion caused by breaking of glass by slight fall of roof, 13333.

Liwynpia, cost of watering, 13516.

Penygraig explosion, dust test, 13646.

Pillars of coal to support arches in mines, views as to, 13331, 13499.

Qualifications of Witness, 13289, 13360.

Scotland: Cubical fracture of coal in certain collieries rendering coal dust less explosive, 13569, 13620.

Shot-firing:
Acts, Orders, Regulations, &c., adequacy of, if strictly observed, 13428, 13432.
Blown out shots, explosions caused by, 13391, 13467.
Notice to manager and permission from him, 13433.
General Rules as to desirable, 13438.
Prohibition of, in mines in which dustless zones are impracticable, views as to, 13431.
Watering within neighbourhood of a shot:
Adequacy of regulations as to, 13432.
Practicable in most mines, 13431.

Timbering, effect of watering on, 13571, 13575, 13608.

Wagons:
Dust from, 13288A (*par.* 3), 13411, 13420.
Loading above sides, 13481, 13483.
Watering as they go along, views as to, 13288A (*pars.* 5 and 6), 13411, 13482, 13485, 13577.
Damage to coal, 13413, 13580.
Importance of as compared with watering roads, 13579.

Watering:
Brine, watering with, 13572.
Brushing away and watering combined, 13421.
Compulsory universal watering, undesirable, 13343, 13364, 13521, 13530.
Cost of, 13496.
Dangers and difficulties of:
Effect on floor, 13488, 13497.
Effect on roof and sides: instance of district ruined by watering, 13288A (*par.* 6), 13307, 13327, 13343, 13348, 13545.
Health of men and horses, effect on, 13545, 13546, 13584.
Extent of and extent advocated: thorough watering unnecessary, 13288A (*par.* 6), 13343, 13439, 13479, 13488, 13576.
Hose, watering with, within 300 yards of pit bottom, 13478.

HOOD, Mr. W. W.—*cont.*

Watering—*cont.*
Hose or tank system, 13489.
Inclination, heavy, aids watering, 13562.
Spray system, 13288A (*par.* 6), 13489.
Temperature of mines, effect of on, 13584.
Timbers, benefited by continuous watering, 13571, 13575, 13608.
Zones watered:
Advantages, comparative, of wet and dry zones, 13395, 13459, 13507.
Arching:
Impracticable in mines where one seam is worked under another, 13309, 13322, 13356.
Iron or steel girders, use of, where brick arching is impracticable, 13535.
Pillars of coal to support arches, 13499.
Cost of, to coal owners, 13635.
Position of arches: question as to possibility of arching 400 or 500 yards from working face, 13638.
Possibility of watering in all mines where arching is practicable, 13532.
Compulsory zone watering, views as to, 13442, 13538.
Arbitration in cases of dispute, 13540.
Cost of, 13396, 13514, 13516.
Explosions, arrest of by, possibility of, 13288A (*par.* 6), 13301, 13342, 13348, 13354, 13504.
Clydach Vale: Explosion apparently not arrested by, 13300, 13302, 13347, 13353, 13378.
Length of zone, views as to, 13353, 13536.
Number of mines in which zone watering would be practicable, 13526.
Number of zones in a district, views as to, 13446.
Position of zones, discretion of management as to advocated, 13445, 13447, 13543, 13550.
Shot-firing, prohibition of, in mines in which dustless zones are impracticable, views as to, 13431.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

MOWATT, Mr. DAVID MARR, General Manager of the Collieries of the Summerlea Iron Company, Ltd. (Scottish Coal Owners'), (*See questions* 17979A—18255.)

Coal Mines Regulation Act:
Definition, more explicit, of dusty mines advocated, 17979A (*pars.* 2 and 7), 18057.
Section 49, General Rule 12, as to shot-firing, 18048, 18121, 18129.
Strengthening of, views as to whether necessary, 18121, 18124.

Delevingne, Mr., evidence of, reference to, 18028, 18181, 18186.

Drumpeller Colliery Explosion:
Arrest of, by damp at pit bottom, 18222, 18224.
Cause of: shot-firing, 17981, 18092, 18160, 18204.
Course traversed by explosion, 18218.
Dust, character of, 17998, 18216, 18220.
Force of explosion, 18217.

Dust:
Danger from:
Face, no danger from dust at, 18003, 18126.
Roads, haulage, danger is chiefly in, and legislation should be confined to, 17979A (*par.* 4), 18001, 18005, 18127.
Definition, clearer, of "dry and dusty" mines advocated, 17979A (*pars.* 2 and 7), 18057.
Experiments, *see that title.*
Explosions, extent to which probably reduced by successful dealing with dust, 17979A (*par.* 1).
Inflammability of various kinds of dust, 17998.
Prevention or removal:
Compulsory, views as to, 18141.
Discretion of manager as to method advocated, 18144, 18150.
Salt or calcium chloride sprinkling, 17979A (*par.* 5).
Vacuum cleaner, use of, 18012.

Digitized by Google

MOWATT, Mr. D. M.—*cont.*

Dust—*cont.*
Prevention or removal—*cont.*
Zones (dry, dustless), views as to, 17979A (*par.* 5), 18147, 18157.
Arching, difficulty of, 18235.
Amount of dust that would be left would probably be dangerous, 18010, 18012, 18120, 18141, 18145.
Scotland, *see that title.*

Dykehead Colliery, explosion at, 18211.

Experiments as to dust, suggestions as to:
Amount of dust, possibly dangerous, that might be left after brushing away, 18145.
Government station for, 17979A (*par.* 3).
Inflammability of various kinds of dust, 17979A (*par.* 2), 17998, 18006.

Explosives Order:
Adequacy of, if strictly observed, 18050.
Definition, more explicit, of "dry and dusty" mines advocated, 17979A (*pars.* 2 and 7), 18057.
Precautions to extend to whole seam where permitted explosives are used, 17991.

Qualifications of Witness, 17980.

Ronaldson, Mr., evidence of, reference to, 18194.

Safety Lamps, *see title* Scotland.

Scotland:
Accidents:
Number of, from falls of roof and haulage, 18020, 18028, 18177.
Increase would probably result from increased use of safety lamps, 18015, 18023, 18025, 18174.
Dust:
Danger from:
Appreciated by Scotch coal owners, 17979A (*par.* 2), 17991.
Extent of appreciation by men, and instruction of men as to danger, 17991.
Not very serious in Scottish mines, 17996, 18135.
Explosions:
Experience of Witness as to, 17979A, 17981.
Small number of, 18137.
Prevention, *see title* Dust, *sub-heading* Prevention or removal.
Explosions:
Drumpeller Colliery, *see that title.*
Ignitions of gas as distinguished from, 18193, 18199, 18205.
Naked light collieries, explosions in, 18197, 18202, 18206.
Number of, and death rate from, 18016, 18137, 18186.
Report of, Rule as to, 18190.
Breach of, Witness knows of no instance of, 18202.
Explosives:
Arkite and Saxonite, use of, in Summerlee Iron Company's Collieries, 18100.
Bobbinite, disuse of, in Summerlee Iron Company's Collieries, 18098.
Carbonite not used in Summerlee Iron Company's Collieries, 18101.
Roburite, use of, at Drumpeller Colliery, 17982.
Haulage accidents, number of, 18020, 18028, 18177.
Increase would probably result from increased use of safety lamps, 18029.
Ignitions of gas:
Distinct from explosions, 18193, 18199, 18205.
Experience of Witness as to, 18199.
Number of, and importance of, 18193.
Price of coal at pit's mouth lower than in any other district of Great Britain, 17979A (*par.* 9).
Safety lamps:
Accidents from falls of roof and sides and from haulage, number of, would probably be increased by increased use of safety lamps, 18015, 18023, 18174.
Statistics proving, 18025, 18176.

MOWATT, Mr. D. M.—*cont.*

Scotland—*cont.*
Safety lamps—*cont.*
Compulsory use of, in dusty mines where watering or brushing away of dust is impossible, views as to, 17979A (*par.* 6), 18014, 18033, 18036, 18158.
Best type of lamp should be used in such mines, 18039.
Explosions in naked light collieries, 18197, 18202, 18206.
Shot-firing:
Acts, Orders, Regulations, &c.:
Adequacy of, views as to, 18120, 18124.
Strict observance necessary in dusty mines where watering or brushing away is impossible, 17979A (*par.* 6), 18014, 18033, 18120, 18158.
Between shifts:
Prohibition of shot-firing except between shifts, views as to whether desirable, 17979A (*pars.* 8 and 9), 18042, 18048, 18058, 18102, 18120.
Stoop and room workings; two shots fired by hewers themselves during shifts, 18102.
Drilling holes, stemming and charging shot, should be supervised by shot-firer himself, 18160, 18166.
General Rule advocated, 18162.
Extent of, in stoop and room workings, 18113, 18228.
Face, no danger from shot-firing in: danger occurs in haulage roads, 18089, 18097.
Former method, 18230.
Miss-fire shots:
Danger from, 18163, 18232.
Explosions at Drumpeller, *see title* Drumpeller.
Notice to manager or under-manager, and permission from him before shot is fired in main haulage road, views as to, 18039, 18122, 18124, 18159.
Person firing shots, 18172, 18241.
Instruction of, 17991, 18168.
No single individual to carry both explosive and means of firing it: General Rule to this effect undesirable, 18042, 18054.
Safety-lamp mines, all shots in, fired by officials, 18115.
Stoop and room workings, 18115.
Ripping or brushing shots, 18062, 18106, 18241, 18248.
Employment of rippers or brushers by company or contractors, 18244, 18252.
Solid, firing in, 18229, 18231.
Watering in neighbourhood of a shot, extent necessary, 18045.
Wagons:
Lights on, impracticable, 18032.
Watering, suggestions as to, 17979A (*par.* 5), 18006, 18147.
Compulsory universal, undesirable, 17979A (*par.* 6).
Dangers and difficulties of, effect on roof and sides, 17979A (*par.* 5), 18151.
Zones, suggestions as to, 18010, 18120.
Arching, difficulty as to, 18011, 18153, 18235.
Arrest of explosion by, instance of, 18222, 18224.
Length of, 18009.

Shot-firing, *see title* Scotland.

Skellington, Larkhill, explosion, 18207.

Udston Colliery: dust, character of, 17998.

Watering, *see title* Scotland.

NEVIN, Mr. JOHN, J.P., Mining Engineer and Colliery Owner. *(West Yorkshire Coal Owners' Association).* (*See questions* 14182A–14459).

Accidents:
Falls of roof and sides, number of, as compared with accidents from other causes, 14182A (*par.* 6), 14432.
Timbering, extent of, effect of on number of accidents, question as to, 14333.

Digitized by Google

NEVIN, Mr. J.—*cont.*

Altofts Colliery Explosion, cause of, 14406.

Belgian Mines visited by Witness, character of, 14192.

Brancepeth Explosion, cause of, 14197.

Cadeby Colliery: Fans and pipes for exhausting dust, system of, 14211, 14450.

Durham, shot-firing, accident from, 14265.

Dust:
- Classification of mines as dusty and non-dusty, difficulty of, 14182A (*par.* 1), 14195.
- Explosions:
  - Cause of, 14182A (*pars.* 2 and 3), 14197, 14203, 14239.
- Face, dust at, amount of and inflammability of, views as to, 14205, 14208, 14306.
- Inflammability of various kinds of dust: fine dust on sides and timbers in main haulage roads most inflammable, 14182A (*pars.* 2 and 6), 14199, 14203, 14246.
- Prevention or removal of, views as to:
  - Cementing of sides and roof, views as to, 14289, 14456.
  - Mixing of non-inflammable material with dust, not advocated, 14182A (*par.* 7), 14202, 14262.
  - Salt, 14182A (*par.* 7), 14260.
  - Sand blast, 14262.
  - Screening-plant, dust from, 14182A (*par.* 4).
    - Amount of, 14216, 14308.
    - Dumb drift in downcast shaft, 14453.
    - Fans and exhausting chamber, 14211, 14450.
    - Raising side of pit, 14310.
    - Removal of screens to distance from downcast shaft, 14182A (*par.* 5), 14213, 14310, 14450.
    - Shaking screen and belts, increased amount of dust from, 14216.
  - Zones (dry, dustless), suggestions as to, 14182A (*par.* 6), 14389:
    - Absolute freedom from dust, impossibility of securing, in deep and hot mines, 14182A (*par.* 5), 14235.
    - Advantages, relation of dry and wet zones, question as to, 14455.
    - Arching, 14182A (*par.* 6), 14257, 14287, 14355, 14359, 14456.
    - Fiery and non-fiery mines, distinction between, question as to, 14297.
    - Length, greater, probably required for dry than for wet zones, 14259.
    - Position of, views as to, 14276.
- Roadways, main-haulage roads, inflammable character of fine dust in, 14182A (*par.* 3), 14199, 14203, 14246.
- Sources of, enumerated, 14182A (*par.* 4), 14306.

Experiments as to dust advocated, 14182A (*par.* 8), 14274.
- Gallery, necessity for, 14275.

Explosions:
- Extent of, experience of Witness as to, 14350, 14384.

Explosives Order, definition of fiery and non-fiery mines contained in, 14297.

Fiery Mines, definition, 14297.

Germany, watering system:
- Application to English mines inadvisable, 14182A (*par.* 8).
- Exemptions, 14302.

Haulage:
- Causes of accidents other than falls of roof and sides, 14254.
- Dust blown from wagons, effect of haulage systems on amount of, 14210.
- Number of accidents, 14182A (*par.* 6).
- Watering, danger of haulage accidents increased by, 14182A (*par.* 6), 14253, 14320, 14323.

Inspection of Mines by mine officials: Precautions as to falls of small pieces of roof, question as to, 14333.

Oaks Explosion, dust probably the cause of, 14384.

Owners, attitude of towards reforms, and question as to extent to which affected by cost, 14362, 14426.

Qualifications of Witness, 14183, 14194, 14237.

Seaham Colliery Explosion, Cause of, 14406.

NEVIN, Mr. J.—*cont.*

Shot-firing:
- Acts, Orders, &c., regulating:
  - Strict observance of, importance of, and effect of, on number of, explosions, 14182A (*par.* 6). 14239, 14295, 14316.
  - Stricter rules as to, in main haulage road views as to, 14182A (*par.* 8), 14265.
- Explosions, 14401, 14406.
- Notice to manager and permission from him before shots are fired, views as to, 14268, 14409.
- Object of, in main haulage roads, 14402.
- Official firing shots, 14273, 14313.

Spontaneous Combustion, danger of, increased by watering (stacking of damp coal), 14182A (*par.* 5), 14231, 14395, 14436.

Timber, effect of watering on, 14420.

United States, character of mines, freedom from water and from dust, 14190.

Ventilation, strict observance of rules as to, no instances of explosions known in cases of, 14182A (*par.* 6), 14239.

Wagons:
- Dust from, 14182A (*par.* 4), 14207, 14209, 14307.
- Loading, method of, 14227.
  - Prohibition of loading above sides would not greatly diminish dust, 14230.
- Types of; advantage of dust-tight wagons, &c., 14182A (*par.* 5), 14219.
  - Steel tubs, 14220.
- Watering as they go along, views as to, and as to probable damage to screens from damp coal, 14182A (*par.* 5), 14218, 14231, 14393, 14434.

Watering:
- Compulsory universal, impracticable, 14182A (*par.* 6), 14251, 14325, 14388.
- Danger and difficulty of:
  - Effect on roof, sides and floor, 14182A (*par.* 6), 14250, 14317.
  - Haulage accidents, 14182A (*par.* 6), 14253, 14320, 14323.
  - Spontaneous combustion, 14182A (*par.* 5), 14231, 14395, 14436.
  - Timber, effect on, 14420.
- Extent necessary; floor only inadequate, 14182A (*par.* 6), 14246.
- Owners, attitude towards, 14360, 14426.
- Strata in relation to, 14285.
- Zones, practicability of in Yorkshire mines, views as to, 14389.

West Yorkshire Coal Owners' Association, watering in mines and other precautions, attitude towards, 14360, 14426.

Women and Children, labour in mines, prohibition of, attitude of owners as to, 14429.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

PARRINGTON, Mr. M. W., Agent at the Collieries of the Wearmouth Coal Company, Ltd. (*Durham Coal Owners' Association*). (*See questions* 15448A–15617.)

Accidents:
- Number of and death rate from, from causes other than explosions, in Wearmouth Collieries, 15448 (*par.* 6), 15538, 15583.
- Increase in number of falls of roof and sides during summer owing to natural moisture, 15562, 15570.

Dust in Mines:
- Classification of mines as dusty and non-dusty, possibility of, 15448A (*par.* 1), 15445, 15456.
- Explosions, causes of, 15448A (*par.* 2).
  - Amount of dust required to carry on an explosion, views as to, 15461.
- Inflammability of various kinds of dust, 15448A (*par.* 2).
  - Roadways, main haulage, dust most explosive in, 15448A (*par.* 3).
  - Screening-plant, dust from, question as to whether inflammable, 15463.
- Prevention or removal of:
  - Brushing away from main haulage roads, extent to which practised in Wearmouth Collieries, 15448A (*par.* 7), 15604.
  - Cost of, 15610.
  - Frequency of, 15605.

Digitized by Google

PARRINGTON, Mr. M. W.—*cont.*
Dust in Mines—*cont.*
Prevention or removal of—*cont.*
Compulsion as to prevention, views as to whether desirable, 15608.
Salt, sprinkling, 15448A (*par.* 7).
Screening-plant, dust from, 15448A (*par.* 4).
Deposited not far from bottom of shaft, 15465.
Fan for collection of dust, 15448A (*par.* 5), 15490.
Inflammability of, views as to: Witness unable to inflame dust with a naked light, 15463.
Partition between downcast shaft and screen preferable to removal of screens, 15448A (*par.* 5), 15483, 15600.
Brick wall at Wearmouth Colliery, 15484.
Whitewashing of refuge holes, 15448A (*par.* 7).
Sources of dust enumerated, 15448A (*par.* 4), 15464.
Face, dust not blown from, 15467.
Wagons, dust from, *see title* Wagons.
Watering, *see that title.*
Experiments as to Dust: Central laboratory for each coalfield advocated, 15448A (*par.* 8), 15551.
Explosions, none in Wearmouth Colliery in 72 years, 15584.
(*See also titles* Dust *and* Watering.)
Germany, watering system, adoption in England, views as to whether desirable, 15540, 15549, 15598.
Qualifications of Witness, 15449.
Safety Lamps, use of in Wearmouth Collieries, 15448A (*par.* 2).
Shot-firing:
Abolition of, in Wearmouth Collieries, 15589, 15615.
Acts of Parliament, regulations, &c., adequacy of, if properly carried out, 15617.
Refuge holes, construction of in Wearmouth Collieries, shot-firing during, no accidents resulting from, 15592.
Watering in neighbourhood of a shot not practised during this work, 15594.
Wagons:
Dust from, 15448A (*par.* 4), 15464, 15469.
Dust-tight wagons, type advocated, 15448A (*pars.* 4 and 5), 15469, 15480, 15602.
Steel wagons, accidents (crushing of men), liable to happen, 15472.
Watering as they go along:
Injury would result to some kinds of coal, 15448A (*par.* 5), 15482.
Not practised in Wearmouth Collieries, 15478.
Watering:
Compulsory universal watering not advocated, 15598.
Cost of complete watering, estimate of, 15448A (*par.* 6), 15505.
Danger and difficulty of:
Effect on roof and sides, 15448A (*par.* 6), 15492, 15499, 15538, 15564.
Health of miners, effect on, 15448A (*par.* 6), 15528.
Extent desirable:
Roof and sides, as well as floor, 15448A (*par.* 6), 15492, 15497.
Thorough watering, views as to, 15448A (*par.* 6), 15540, 15598.
Wearmouth Collieries, extent of in, 15558.
(*See also subheading* Zones.)
Frequency of, views as to, 15448A (*par.* 6), 15499.
Sanitary purposes, watering for, inadvisable, 15530.
Spraying tubs, use of, 15448A (*par.* 6), 15564.
Zones, watered (arched and paved zones), views as to, 15448A (*par.* 6).
Arching and paving, cost of, estimate of, 15448A (*par.* 6), 15515.
Arrest of explosion by thorough zone watering, more probable than by complete watering superficially done, 15448A (*par.* 6), 15502, 15545, 15581, 15598.
Cost of, estimate of, 15448A (*par.* 6), 15507.
Length required to arrest explosion, views as to, 15504.
Number of zones that would be required in Wearmouth Collieries, 15514, 15580.
Zones, *see title* Watering, *sub-heading* Zones.

PEACE, Mr. G. H., Managing Director of the Astley and Tyldesley Collieries, Ltd. (*Lancashire and Cheshire Coal Association*). (*See questions* 16112A—16368).

Accidents:
Number of, from falls of roof and sides:
Timbering system in force in some Lancashire mines, question as to effect of, on, 16187.
Watering, probable effect of, on, 16112 (*pars.* 5 and 6), 16156.

Bell, Mr., evidence of, reference to, 16364.

Courrières Mine Explosion, dust analysis, showing effect of non-inflammable dust in arresting explosion, 16112A (*par.* 16), 16204, 16234.

Deep Mines:
Crush not always greatest in, 16305.
Dust, depth of mines in relation to, 16321A.
Watering, danger and difficulty of, in, 16112A (*par.* 6), 16158.
Effect of, on health of miners, 16112A (*par.* 12), 16197.

Dust in Mines:
Classification of mines as to dust:
Differentiation, further, suggestion as to, 16176.
Definition of a dusty mine, question as to, 16326.
Depth of mines in relation to amount of dust, 16321A.
Explosions, amount of dust required to cause or carry on, 16178, 16205.
Inflammability of various kinds of dust, 16202:
Experiments as to, advocated, 16112A (*par.* 17), 16180.
Screening-plant, fine dust from, inflammability of, 16143, 16287.
Prevention or removal of:
Brushing away practised in Astley and Tyldesley Collieries, 16169, 16333.
Cost of less than of watering, 16335.
(*See also sub-heading* Zones.)
Compulsory prevention or removal of, views as to whether desirable, 16336.
Mixing of non-inflammable material with dust, views as to, 16112A (*par.* 16), 16202, 16234.
Salt sprinkling, views as to, 16112A (*par.* 15), 16151.
Screening-plant, dust from:
Carrying-up of sides of shaft, views as to, 16296.
Dumb drift communicating with downcast shaft for ventilation, views as to this suggestion, 16144, 16289.
Experiments as to methods of prevention, Astley and Tyldesley Mines, 16328.
Fans or other appliances for prevention of dust from going down downcast shaft, 16112A (*par.* 4), 16137.
Compulsory provision, views as to, 16142.
Inflammability of, 16143, 16287.
Removal of screens to distance from shaft difficult in old collieries, but screens should be placed at distance in new collieries, 16112A (*par.* 3), 16138, 16328.
Distance advocated, 16140.
Walls and screens between screening-plant and downcast shaft, views as to, 16137.
Timbering system adopted in some Lancashire mines, rendering complete clearing away of dust possible, 16184.
Zones (dry, dustless):
Advantages of, as compared with wet zones, 16112A (*par.* 9 and 14), 16167, 16169, 16256.
Arching, difficulty and costliness of, 16112A (*par.* 10), 16182, 16300.
Arrest of explosion by, views as to, 16168.
Experiments as to efficacy of brushing away cited and advocated, 16259, 16337.
Watering dust (damping floor) before brushing away not advocated, 16170.

Digitized by Google

PEACE, Mr. G. H.—*cont.*

Experiments as to dust, suggestions as to:
Amount of dust required to carry on an explosion, 16178.
Brushing away, efficacy of, 16259, 16337.
Inflammability of various kinds of dust, 16112A (*par.* 17), 16180.
Zones, 16259.

Explosions, experience of Witness as to: No explosion in Astley and Tyldesley Collieries, 16175.

Explosives used in Astley and Tyldesley Collieries, 16231, 16352.

Germany: Watering system, adoption in England undesirable, 16112A (*par.* 7), 16160.
Alternatives suggested by Dr. Haldane, Mr. Hall and Mr. Atkinson in report on, 16112A (*par.* 8).

Hall, Mr., evidence of, reference to, 16112A (*par.* 15), 16151.

Haulage, slow, effect of, on amount of dust in wagons; spraying unnecessary with slow haulage, 16112A (*par.* 2), 16130.

Method of Working Lancashire Mines:
Longwall system, 16274.
Solid coal on each side of haulage roads in Astley and Tyldesley Collieries, 16275.

Qualifications of Witness, 16113, 16272.

Royal Commission on Explosions from Coal Dust, 1891:
Water cartridges, evidence as to, 16342.

Safety Lamps:
Electric lamps, drawbacks of, 16261.
Insufficient light, 16262, 16313.
Indication of gas not furnished by, 16266:
Apparatus to supply this deficiency, 16265, 16315.
Dangerous gases other than fire-damp might not be indicated by, 16318.
Use of, in Astley and Tyldesley Collieries, 16361

Shot-firing:
Between shifts in main haulage roads:
Prohibition of shot-firing, except between shifts, difficulty of in mines working two shifts, 16112A (*par.* 18), 16206.
Withdrawal of men from mine once a week during shot-firing, question as to possibility of, 16215.
Extent to which practised in Astley and Tyldesley Collieries, 16209.
Face, shot-firing at, 16351, 16353.
Notice to manager and permission from him before shot is fired in main haulage road, Lancashire Special Rule as to, 16307.
Official shot-firer, appointment of, in Astley and Tyldesley Collieries, 16353.
Instruction in duties, 16357.
Water cartridges:
Astley and Tyldesley Collieries, use of, in, 16216, 16221, 16339.
Method of use described, 16346.
Blown-out shots, question as to, 16341.
Gunpowder, use of with, inadmissible, 16342, 16634.
Leakage, possibility of, 16367.
Royal Commission of 1891, evidence of, as to, 16342.
Watering in neighbourhood of a shot, extent required—roof and sides as well as floor, 16190.

Timbering:
Steel or iron props unsatisfactory, 16298.
System, modified, adopted in some Lancashire collieries; complete cleansing from dust possible with, 16184.
Watering, effect of, on, 16112A (*par.* 6), 16157 16298.

Wagons:
Dust from, amount of, 16112A (*par* 2), 16130, 16133.
Dust-tight iron wagons, advantage of, 16112A (*par.* 1), 16120, 16329.
Comparison with wooden wagons, 16112A (*par.* 1), 16120.
Danger of iron wagons on steep inclines, views as to, 16128.
Watering of coal in, not required with slow haulage system, 16112A (*par.* 2), 16130.

PEACE, Mr. G. H.—*cont.*

Watering:
Compulsory universal, impracticable in many mines; exemptions would have to be numerous, 16112A (*par.* 7), 16160, 16256.
Danger and difficulty of:
Effect of on roof, sides and floor, 16112A (*pars.* 5 and 6), 16147, 16153, 16284.
Bricking of floor, views as to, 16154.
Nature of roof in relation to, 16279.
Health of men, effect of, on, 16112A (*par.* 12), 16197.
Timbering, effect of, on, 16112A (*par.* 6), 16157, 16298.
Deep mines, difficulty in, 16112A (*pars.* 6 and 13), 16158, 16197.
Extent possible and desirable, 16112A (*par.* 8), 16150, 16191.
Thorough watering impracticable in many mines, 16112A (*par.* 5), 16147, 16284.
Frequency with which necessary, 16112A (*par.* 6).
Tank and hose system, small cost of, 16112A (*par.* 11), 16190.
Zones:
Advantages of, less than of dry zones, 16112A (*pars.* 9 and 14), 16167, 16169, 16256.
Arching, difficulty as to, 16112A (*pars.* 8 and 10), 16162, 16182, 16275.
Length of, 16161.
Position of (not advocated at far end of haulage roads), 16162.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

PILKINGTON, Mr. CHARLES, Director of the Clifton and Kersley Coal Company, Ltd., of Clifton, near Manchester; (*Lancashire and Cheshire Coal Association*). (*See questions* 14894A—15171.)

Accidents:
Falls of roof and sides, frequency of, as compared with explosions, 14894A (*par.* 4), 14936.

Ankylostomiasis:
Experience of Witness as to, extent of, 14959.
Temperature and depth of mines in relation to, 14894A (*par.* 4), 14960.

Deep Mines:
Ankylostomiasis, danger of in, 14961.
Arching in, difficulty of, 15033.
Watering in, objections to, 14894A (*par.* 4), 14932.

Dust in Mines:
Depth of dust justifying description of roads as dusty, 15067.
Explosions: returns traversed by, instance of, 15108.
Inflammability of various kinds of coal dust:
Experiments as to, carried out as suggested by Professor Dixon, 14918, 15006, 15017, 15115.
Fine dust from roof most inflammable, 15006, 15017.
Returns, dust in, 15117.
Screening-plant, dust from, more inflammable than dust from main haulage roads, 14916, 15027.
Prevention or removal of:
Brushing away in main levels and main jigs in mines worked by Witness, 15134, 15146.
Salt, sprinkling with, views as to, 14894A (*par.* 6), 14964.
Health of miners, probable effect on, 14967.
Screening-plant, dust from:
Fan for collecting dust, 14849A (*par.* 1), 14923.
Importance of preventing dust going down shaft, 14916, 14999.
Inflammability of, 14916, 15026.
Partition between screen and shaft and carrying shaft certain distance in air, views as to, 14928.
Removal of screens to distance from downcast shaft, 14894A (*par.* 1), 14916.
Spraying inside shaft, views as to, 14929.
Vacuum cleaner, suggestion as to, 14894A (*par.* 5), 14950.

Digitized by Google

PILKINGTON, Mr. C.—*cont.*

Dust in Mines—*cont.*
Prevention or removal of—*cont.*
Zones, dry dustless, views as to:
Arching, 15032, 15033.
Arrest of explosion by, views as to, 15129.
Discretion of manager as to advocated, 15035.
Iron or steel girders, substitution of for timber in, suggestion as to, 15030.
Jets of compressed air, suggestion as to for ordinary unprepared roads, 15029.
Shape of zones, experiments as to advocated, 14948, 14950.
Watering (damping) of dust before sweeping advocated, 14894A (*par.* 5), 14947, 14963.
Weight of various dusts, 15020, 15115, 15123.

Experiments:
Dust, inflammability of various kinds, experiments as to:
Bramall, Mr, experiments by, 15026.
Dixon, Professor, experiments as suggested by, 14918, 15006, 15017, 15115.
Zones, watered, experiments as to advocated, 14948, 14950, 14989, 14993, 14996.

Explosions:
Experience of Witness as to, extent of, 14940, 15108, 15126.
Return airway rarely affected by, 15108.

Explosives in Coal Mines Order, stringency of, 14894A (*par.* 7).

Germany: Watering in Westphalian mines, physical conditions favourable to, 15090.

Owners' readiness to adopt measures for minimising dangers from coal dust, 15004.

Qualifications of Witness, 14895.

Safety Lamps, extent to which used in mines worked by Witness, 14942.

Shot-firing:
Acts, Orders, &c., stringency of, and importance of strict observation of, 14894A (*par.* 7), 14999.
Suggestion as to General Rules, 14969, 14973.
Between shifts and after withdrawal of men, 15100, 15101.
Blown-out shots in main road, suggestion as to period to elapse before another shot is fired, 14894A (*par.* 7), 14973, 15034.
Notice to manager and permission from him before shot is fired in main roads, views as to, 14982.
Number of shots fired simultaneously: prohibition of more than one shot in main road advocated: place to be examined between each shot, 14894A (*par.* 7), 14969, 15034.
Special Rules, Lancashire, 14982, 15034.
Under-manager to be present when shots are fired in main roads, suggestion as to, 14894A (*par.* 7), 14982.

Wagons:
Dust from, 14894A (*par.* 1), 15144, 15162.
Period that wagons will last, 15148.
Type advocated, advantages of dust-tight steel or iron wagons, &c., 14894A (*par.* 1), 15002, 15150.
Compulsory introduction of dust-tight wagons inadvisable, 15000.
Cost of introducing new dustless types, question as to, 15151.
Strips of wood across fissures, 15163.
Wooden wagons, objections to, 14896.
Watering wagons as they go along, views as to, 14894A (*par.* 1), 14906.
Depth to which surface of wagons should be watered, 15039.
Spray system, suggestion as to, 15047.

Watering:
Compulsory universal watering, objections to, 14894A (*pars.* 2, 3 and 4).
Cost of compulsory watering, views as to, 14894A (*par.* 3).

PILKINGTON, Mr. C.—*cont.*

Watering—*cont.*
Dangers and difficulties of:—
Effect on roof, floor and sides, 14894A (*pars.* 2 and 4), 14936, 15028, 15064, 15131, 15156.
Health of miners, effect of on, 14894A (*pars.* 2 and 4), 14932, 14990, 15078.
Extent desirable, 14894A (*par.* 2).
Roof, watering of, more important than watering of floor, 14957.
Thorough watering, possible in a few mines, objectionable in many, 14894A (*pars.* 2 and 4), 14931.
Frequency of, circumstances determining, 14894A (*par.* 2).
Spray system, 14894A (*par.* 2), 14957, 15069, 15134.
Syringe or shoot of water for roof, suggestion as to, 14957.
Zones, watered, views as to, 14894A (*par.* 2), 14982.
Arched and paved zones advocated, 14894A (*par.* 2).
Arrest of explosion by, possibility of, 14894A (*par.* 2), 14946.
Compulsory zone watering, views as to 14990.
Cost of, views as to, 14954.
Experiments as to, advocated, 14989, 14993, 14996.
Length of zone required, views as to, 15097.
Position of, views as to:
Face, distance from, 15094.
In mines of very sharp gradient, 15142.

Wood Pit Explosion, Haydock, returns traversed by, 15109.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

RHODES, Mr. CHARLES EDWARD, Mining and Consulting Engineer (*South Yorkshire Coal Owners' Association.*) (*See questions* 18255A—18580.)

Altofts Colliery Explosion, arrest of, before reaching face, 18546.

Coal Mines Regulation Act, 1887:
General Rule 12 as to shot-firing, interpretation of, 18418.
"Safety Lamps," use of term, in, 18470, 18474.

Denaby Colliery: Fans and pipes for preventing dust from screens from going down downcast shaft, 18444.

Dust in Mines:
Act of Parliament dealing with, absence of, except as regards shot-firing, 18395.
Character of mines as regards dust, 18255A (*par.* 3).
Danger from: extent to which realised, 18498.
Experiments, *see that title.*
Explosions:
Cause of:
Amount required to cause explosion, experiments as to, not made by Witness, 18299A.
Gas always present, possibly in infinitesimal quantity, 18255A (*par.* 1), 18265, 18380, 18522.
Small amount sometimes more dangerous than large; Witness does not agree with this opinion, 18382.
Separation of inflammable from non-inflammable dust by, views as to, 18384.
Goaf, dust in, 18323, 18375.
Danger from, views as to, 18495.
Vacuum cleanser, clearing away by, views as to, 18453.
Inflammability of various kinds of dust, 18389, 18393, 18495, 18497.
Inspection of mine by mines official, inclusion of dust in reports, views as to, 18568.
Mixing, mechanical, of coal dust with other dust, 18383.
Prevention or removal of:
Brushing away, suggestion as to in dusty mines, where watering is impracticable, 18255A (*par.* 10), 18318, 18398, 18401.

Digitized by Google

RHODES, Mr. C. E.—*cont.*

Dust in Mines—*cont.*
Prevention or removal of—*cont.*
Amount of dust that would be left would probably be innocuous, 18255A (*par.* 12), 18318, 18400, 18407.
Compulsion as to, views as to whether desirable, 18351, 18395, 18446, 18449.
Importance of, when gas is present in working face, 18535.
Sanitary purposes, importance of, for, 18319, 18320.
Screening-plant, dust from, 18442, 18512.
Universal system impracticable owing to different conditions in different mines, 18255A (*pars.* 2 and 10), 18349A.
Vacuum cleaner, use of, views as to, 18322, 18453.
Watering, *see that title.*
Zones (dry, dustless):
Compulsory provision, views as to, 18449.
Discretion of manager as to wet or dry zones and as to length of zones advocated, 18450, 18451.
Riddles, use of, effect of on amount of dust, 18325, 18488.

Experiments:
Dust, experiments as to:
Amount of dust required to cause an explosion, experiments as to advocated, 18411.
Conducted by Witness: Explosion not obtained by dust alone, small amount of gas invariably present, 18255A (*pars.* 1, 8 and 10), 18262, 18265, 18389, 18520, 18522.
Inflammability of dust, length of zones, &c., experiments as to advocated, 18456.
Explosives, permitted, experiments as to, advocated, 18411.
Safety lamps, experiments conducted by Witness, 18255A (*pars.* 1 and 9), 18262.
Shot-firing, experiments conducted by Witness, 18288, 18516.
Cartridges used, 18519.

Explosions:
Area of, instance of explosion extending for 200 yards, 18346, 18368.
Face, extent to which traversed by, 18536, 18542.
Number of, 18542.
(*See also title* Dust.)

Explosives, Permitted:
Experiments as to, 18411, 18516.
Safety of, views as to, 18296.
Term "Safety," objections to, 18412, 18468.

Fiery Mines, 18255A (*par.* 3), 18365, 18531.

Inspection of mine by mines officials, suggestion that dust should be mentioned in reports, 18568.

Methods of Working, 18255A (*pars* 2 and 5), 18273.

Middlefield Explosion, arrest of, before reaching face, 18546.

North Derbyshire Collieries, shot-firing practised in coal itself; non-fiery character of seams, 18255A (*par.* 2), 18366.

Qualifications of Witness, 18255A, 18256.

Rescue Apparatus:
Experience of Witness as to, experiments with Fleuss apparatus, &c., 18457.
Fire, use of pneumataphors in case of, views as to, 18460, 18559.
Pneumataphors, 18460.
Property more likely to be saved by than life, 18459, 18558.
Stations for experiments and for training men advocated, 18458, 18460, 18562.
Training men, 18458.

Royal Commission on Coal Dust in Mines, experiments by Mr. Rhodes, results of placed at disposal of, 18255A (*par.* 1), 18263, 18520.

Safety Lamps:
Safety of, views as to, 18470.
Types of, experiments by Witness, 18255A (*pars.* 1 and 9), 18262.

RHODES, Mr. C. E.—*cont.*

Shot-firing:
Abolition of, views as to, 18255A (*par.* 4), 18275, 18314.
Acts, Orders, Regulations, &c.:
Adequacy of, if strictly observed, views as to, 18425.
Number of men in pit during shot-firing, General Rule as to, views as to whether desirable, 18281.
Strengthening, views as to, 18427.
Strict observance of in dusty mines, necessity for, 18255A (*par.* 10).
Watering in neighbourhood of a shot, General Rule 12 as to, interpretation of, 18418.
Between shifts: views as to prohibition in main haulage roads, except between shifts, 18255A (*par.* 6), 18276, 18277, 18358, 18549.
Ripping shots, 18255A (*par.* 7), 18277, 18543.
Blown-out shots, 18255A (*par.* 1), 18266, 18463, 18547.
Detonators:
Defective, percentage of, 18289.
Testing, method of, 18292.
Drilling, defective, danger of, and views as to desirability of special instruction to shot-lighters as to, 18432, 18436.
Explicit directions, difficulty of, 18432.
Experiments with permitted explosives, 18516.
Cartridges, water and other kinds, use of, 18519.
Extent to which practised in different seams, 18255A (*pars.* 2, 3, 4, 5 and 7), 18273, 18279, 18365, 18542, 18548.
Face, shot-firing in, 18540.
Miss-fire shots:
Time that should elapse before men approach shot or before another shot is fired, 18287, 18294, 18428, 18506.
Notice to manager and permission from him before shot is fired in main haulage road, views as to, 18300, 18427.
Checking off of all shots by competent man, suggestion as to, 18300.
Number of shots to be fired simultaneously; prohibition of more than one advocated; interval to elapse between each shot, 18283, 18507, 18510.
Roads, main haulage, danger of shot-firing in, 18548.
South Yorkshire, *see that title.*
Stemming and tamping, 18255A (*par.* 8), 18295, 18462.
Ventilation, importance of, in relation to, 18526.
Water cartridges, difficulty in use of, owing to carelessness of men, 18519.
Watering in neighbourhood of a shot:
Acts, Orders, &c., as to:
General Rule 12, interpretation of, 18418.
Strict observance of, importance of, in dry and dusty mines, 18255A (*par.* 10), 18297.
Area to be watered, increase advocated where much dust is present, 18306.
Damping, views as to, 18311, 18553.
Decision as to, person responsible for, 18300.
Face, watering at, question as to, 18364.
Testing efficiency of watering before shot is fired, question as to, 18556.

Timber and Bars, method of conveying to face, 18476.

Ventilation:
Act of Parliament regulating; clearer definition of adequate ventilation, views as to, 18526.
Percentage of gas in mines, 18527.
Standard of, 18532.

Wagons:
Dust from, 18326, 18492.
Repair, 18334, 18477.
Type of Wagon, 18327.
Watering of coal in; injury to screens would probably result, 18330, 18332, 18484

Digitized by Google

RHODES, Mr. C. E.—*cont.*
Watering:
Compulsory universal, impossibility of, 18255A (*pars.* 10 and 12), 18315.
Advocated where roof, floor and sides will allow, 18316, 18350.
Cost of, 18355.
Danger and difficulty of; effect on roof, floor and sides, 18255A (*pars.* 3, 5 and 10), 18316, 18337.
Extent of:
Damping with a spray, views as to, 18255A (*par.* 11), 18339, 18378.
Zones:
Advantages of dry and wet zones compared, 18255A (*par.* 12), 18503.
Arrest of explosion by, views as to, 18368.
Length of, views as to, 18344, 18368, 18504.
Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

RICHARDS, Mr. T. TALIESIN, Agent and General Manager to Messrs. Locket's, Merthyr Collieries, Ltd. (*National Association of Colliery Managers*). (*See questions* 12136A—12653.)
Accidents:
Falls of roof and sides, number of deaths from, as compared with number from explosions, 12136A (*par.* 6), 12218, 12590.
Comparative number of accidents in wet and dry mines, absence of statistics as to, 12223.
Albion Colliery Explosion, arrest of, by damp floor, 12230.
Barriers of Coal left under railways and waterways, 12621, 12628.
Belgium:
Dust in deep mines, 12614.
Watering in deep mines, effect of, on health of men, 12300.
"Comet" dust experiments with, 12136A (*par.* 2), 12150, 12416, 12551.
Definition of a comet, 12417.
Deep Mines:
Coal supplies of future will come largely from, 12473.
Dust:
Character of, in, 12614.
Prevention by arched zones, impossible in very deep mines, 12470.
Dust in Mines:
Classification of mines as dusty or non-dusty, difficulty of, 12136A (*par.* 1), 12145.
Deep mines, dust in:
Character of, 12614.
Prevention by arched zones, impossibility of, 12470.
Explosions:
Amount of dust required to create, 12136A (*par.* 2).
Causes of, manner in which dust is ignited, &c., 12136A (*par.* 2), 12148, 12170, 12413, 12490, 12492.
Experiments as to cause, advocated, 12136A (*par.* 7), 12305.
(*See also sub-heading,* Inflammability of various kinds of dust.)
Merthyr Colliery explosion, 12189.
Face of Mine, dust at:
Amount, small, 12322.
Non-injurious character of, 12136A (*par.* 3), 12174, 12406, 12489, 12608.
Inflammability of various kinds of dust, 12136A (*pars.* 2 and 3), 12148, 12401, 12487, 12608.
Coal dust is only kind of explosive dust, 12420.
Roads, main haulage, dust in, 12136A (*par.* 3), 12147, 12173, 12311, 12487, 12498, 12599, 12646.
Not always explosive, 12136A (*par.* 4), 12199, 12428.
Prevention or removal of, by other methods than watering:
Absolute removal, impossibility of, 12243, 12475.
Brushing away periodically, 12136A (*par.* 5), 12509, 12569, 12582.

RICHARDS, Mr. T. T.—*cont.*
Dust in Mines—*cont.*
Prevention or removal of, by other methods than watering—*cont.*
Consideration of this question by officials, 12507, 12569, 12582.
Importance of dust removal, 12613.
Mixing of innocuous matter with explosive dust, 12148, 12199, 12421, 12428.
Paving floor, views as to, and as to impracticability of in South Wales, 12136A (*par.* 5), 12256, 12571.
Screening-plant, dust from, 12136 (*par.* 4).
Removing screens to distance from downcast shaft not advocated, 12136A (*par.* 4), 12191, 12431, 12568.
Vacuum cleanser, unsatisfactory working of, 12136A (*par.* 5), 12210, 12214.
Zones (arched, dry, dustless), views as to, 12136A (*par.* 7), 12212, 12478, 12535, 12570.
Advantage of, as compared with wet zones, views as to, 12252, 12327.
Besoms, use of, 12443.
Cost of, 12449.
Deep mines, impossibility of arching in, 12470, 12628.
Frequency of sweeping, views as to, 12437.
Length of zone, 12254.
Paving, 12136A (*par.* 7), 12256.
South Wales, impracticability of in, 12136A (*par.* 7), 12302, 12538.
Steel or iron props or cross-bars, 12544.
Watering combined with brushing away, views as to, 12244.
Sources of explosive dust, general account of, 12136A (*par.* 4).
Wagons, dust from, *see title* Wagons.
Experiments as to coal dust advocated, 12136A (*par.* 7), 12305, 12404.
Explosions:
Dust in relation to, *see title* Dust.
Face of mine, safest place in event of, 12489, 12608.
Number of deaths from, as compared with number from falls of roof and sides, 12136A (*par.* 6), 12590.
Germany, watering of mines in:
Cost of watering on similar lines in England, estimate, 12262.
Exemptions, 12136A (*par.* 6), 12220.
Gray, Mr., evidence of, reference to, 12257.
Hodges, Mr., evidence of, reference to, 12214.
Maclaren Colliery Explosion, cause of, 12648.
Mountain Ash Colliery, working of four-feet seam, 12575.
Nixon's Navigation Colliery, working of four-feet seam, 12575.
Pillars at bottom of pit, crush reduced by, 12540, 12623.
Pontypridd Officials' Association, consideration of question of dealing with dust, 12569, 12581.
Qualifications of Witness, 12137.
Rhondda Four-feet Seam, watering in, 12136A (*par.* 6).
Shot-firing:
Acts, Orders, Regulations, &c., greater stringency in, not required, 12481, 12492.
Explosions, extent to which caused by, 12173, 12598.
General Rule, difficulty as to, owing to different conditions, 12136A (*par.* 7).
In neighbourhood of considerable falls and packing, question as to, 12498, 12599.
Main haulage roads, shot-firing most dangerous in, and should be under strict regulation, 12136A (*par.* 7), 12173, 12309, 12599.
Notice to manager and permission from him, General Rule as to, advocated, 12494.
Watering in neighbourhood of a shot, importance of, and views as to extent required, 12136A (*par.* 7), 12498.
Complete removal of dust by other means, advocated when necessary, 12309.

Digitized by Google

RICHARDS, Mr. T. T.—*cont.*

Wagons:
Dust from, 12136A (*par.* 4).
Dust-tight iron or steel tubs, advantages of, 12136A (*par.* 5), 12178, 12194, 12325, 12559.
Screening-plant, modification of old type necessary if doors are to be added to wagons, 12557.
Loading above top, prohibition of, views as to undesirability of, 12195.
Watering coal in, views as to, 12136A (*par.* 5), 12195, 12239, 12324.
Coal would only be slightly injured by, 12197.

Water (Natural) in Mines:
Damage from, possibility of, 12478, 12528, 12586.
Dust prevented by, 12136A (*par.* 6).

Watering in Mines:
Brushing away of dust combined with watering, views as to whether practicable, 12243.
Compulsory universal watering not advocated, 12136A (*par.* 6), 12218, 12315, 12462, 12594.
Exemptions, system of, would be necessary, 12136A (*par.* 6), 12463.
Cost of, estimate of, and views that cost of compulsory watering would be prohibitive, 12136A (*par.* 6), 12257, 12262, 12640.
Dangers and difficulties of:
Effect on roof and sides, 12136A (*par.* 6), 12218, 12584, 12595.
Death rate from falls of roof and sides in wet as compared with dry seams, absence of statistics as to, 12223.
Effect on floor, 12136A (*par.* 6).
Haulage, difficulties of, in roads with high gradients would be increased by, 12136A (*par.* 6), 12294.
Health of horses, possible effect on, 12136A (*par.* 6), 12291.
Health of miners, possible effect on, 12136A (*par.* 6), 12296, 12300.
Wages, increase demanded on this account, 12136A (*par.* 6), 12298.
Impossibility of watering in some mines, 12247, 12477.
Decision as to watering should rest with managers, 12505.
Explosion, Albion Colliery, arrested by watered floor, 12230.
Extent of:
Adequacy of, views as to, 12321.
Floor only, views as to, 12228, 12230, 12240.
Inspectors of mines, evidence of, as to, 12320.
Zones, *see that sub-heading.*
Spray system advocated, 12136A (*par.* 6).
Wagons, watering coal in, views as to, *see title* Wagons, *sub-heading* Watering.
Zones, 12136A (*par.* 6), 12499, 12550, 12596, 12638.
Comparative advantage of wet and dry zones, 12327.
Cost of, views as to, 12266, 12276, 12283.
Length and position of zones, 12136A (*par.* 6).

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

ROUTLEDGE, Mr. W. H., Mining Agent for Messrs. Partridge, Jones & Co., Ltd., Colliery Proprietors, Monmouthshire (*South Wales and Monmouthshire Coal Owners' Association*). (*See questions* 12919A—13288.)

Accidents:
Falls of roof and sides, number of, in wet and dry pits, absence of any statistics comparing, 12968, 12976, 12983.

Clayeross Colliery Explosion: Cause of (naked lights), 13227.

Deep Mines:
Arching, depth at which probably impracticable, 13124.
Definition of a deep mine, 12928.
Dust question, chiefly affects, 12919A (*pars.* 2 and 3), 12928.
Depth at which dust is dangerous, 13095.

ROUTLEDGE, Mr. W. H.—*cont.*

Derbyshire: Dust experiments by Chesterfield Institute, 12926, 13076.

Discipline, importance of, and effect of on number of accidents, 13167, 13176, 13213, 13261.

Dust:
Deep mines chiefly affected by, 12919A (*pars.* 2 and 3), 12928, 13095.
Explosions, cause of, 13076, 13091, 13250, 13261.
Amount of dust required, 13041.
Face, dust at:
Amount is small and character comparatively harmless, 12952.
Brushing dust towards face would increase danger, 13103.
Inflammability of various kinds of coal dust:
Depth at which dust becomes dangerous, 13095.
Roadways, roof timbers and sides, dust most dangerous on, 12919A (*par.* 4), 12938, 12999, 13100.
Prevention or removal of, views as to:
Mixing of non-inflammable substance with dust, 13043.
Salt, sprinkling, 13044.
Sand-blast, use of, for clearing dust from timbers, 13046.
Steam jets in downcast shaft, 12919A (*pars.* 10 and 11), 12979.
Zones, dustless:
Arching, 12940.
Depth at which impracticable, 13124.
Brushing away (dry, dustless zones):
Absolute freedom from dust, impossibility of securing, by this method, 12919A (*pars.* 6, 7 and 8), 12939, 12946, 13042, 13108, 13156, 13161.
Arrest of explosion by, improbability of, 12941.
Danger caused by driving dust nearer the face, 12919A (*par.* 8), 12940, 12950.
Watering dust before sweeping up, question as to, 12954.
Discretion of managers as to, advocated, 13255.

Experiments:
Advisability of, views as to, 12949, 13094, 13182.
Chesterfield experiments, 12926, 13076.
Watering, experiments as to, 12919A (*par.* 9).

Explosions:
Causes of:
Dust, *see that title.*
Shot-firing, chief cause, 13226.
Experience of witness as to, 13153.
Safety in:
Face frequently the safest place, 13198, 13203.
Instruction of workmen as to, question as to, 13197, 13202.

General Rules, adequacy of, if strictly observed, 12919A (*par.* 18), 13025, 13211, 13218, 13223, 13256.

Germany, watering in, cost of, 13152.

Glyn explosion, cause of, 13228.

Inspection of Mines by Mines Officials:
Number of inspections during shift, difference of opinion between manager and Home Office inspector as to, 12919A (*par.* 19), 13028.

Lancashire, Special Rules as to shot-firing advocated as model for General Rule, 13192.

Llanerch Explosion, cause of, 13228.

Maclaren Explosion, cause of, 13228.

Manager, responsibility of, 13245.
(*See also title* Shot-firing, *sub-heading* Notice to Manager.)

Output in largest mine, 13146, 13150.

Qualifications of Witness, 12919A (*par.* 1), 12920, 13153, 13210.

Digitized by Google

ROUTLEDGE, Mr. W. H.—*cont.*
Royal Commission on Explosions from coal dust in mines, 1894 :
Difficulty experienced by, in dealing with the question, 13253.
Safety Lamps, breach of rules as to, causing an explosion, question as to, 13261, 13262.
Seaham Colliery Explosion, cause of, 13227, 13261.
Shot-firing :
Acts, Orders and Regulations, adequacy of, if strictly observed, 12919A (*par.* 18), 13022, 13024, 13025, 13129, 13167, 13171, 13213.
Revision of Special Rules, 12919A (*par* 19).
(*See also sub-heading* Notice to Manager, &c.)
Between shifts, 13282, 13286.
Blown-out shots, 13261, 13267.
Explosions, cause of, 13226, 13261.
Dust lodged in old crevices, 13264.
Face, shot-firing in, 13273, 13286.
Lancashire, Special Rule, 13192.
Notice to manager and permission from him before shot is fired, General Rule as to, advocated, 13131, 13169, 13187, 13192, 13213, 13218, 13232, 13260.
Watering in neighbourhood of a shot, 13022, 13270.
Special Rules :
Adequacy of, if strictly carried out, views as to, 12919A (*par.* 18), 13025, 13171, 13211, 13218, 13223, 13256.
Conversion of many Special Rules into General Rules, advisability of, 13027.
Wagons :
Dust from, 13007, 13147.
Loading above sides, 13004, 13008.
Type of, views as to dust-tight wagons, &c., 12919A (*par.* 16), 13004, 13009, 13142, 13224.
Watering as they go along :
Advantage of, views as to, 13148.
Discretion of manager as to, preferable to General Rule, 13220, 13222.
Watering :
Acts, General and Special Rules, adequacy of, if rigidly enforced, 12919A (*par.* 18).
Compulsory watering not advocated, 12919A (*par.* 17), 13114, 13118, 13144.
Exemptions would have to be numerous, 13036.
Opposition of witness extends only to cases in which watering would be dangerous, 13164.
Cost of watering, 13048, 13056, 13150.
Danger and difficulty of :
Effect on roof and sides, 12919A (*pars.* 9 and 14), 12966, 12971, 13033, 13063.
Creosoted timber, unsatisfactory as a preventative of rotting, 13030, 13037.
Variations in different mines : greatest danger is in deep mines, 13114, 13116.
Discretion of manager as to, advocated, 12919A (*par.* 16), 13013, 13143.
Experiments, 12919A (*par.* 9).
Extent of and extent desirable, 12919A (*par.* 15), 12985, 12988, 12992, 12998, 13013, 13063, 13140.
Hose and spray with pipes, 12919A (*par.* 12).
Cost of, 13048, 13243.
Length of pipes in Monmouthshire colliery, 12983, 12997, 13047.
Spray and tank system, 12919A (*par.* 9), 12965.
Zone watering, 13120 :
Afterdamp would probably not be arrested by, 13023.
Arching or steel rails, views as to, 13033, 13121.
Arrest of explosion possible, but not prevention, 12919A (*par.* 17), 13020, 13181.
Compulsion as to, not advocated, 13178, 13249.
Cost of, estimate of, 13048, 13243.
Danger and difficulty of : effect on roof and sides, 13033.
Creosoted timber, views as to, 13030, 13037.
Discretion of manager as to advocated, 12919A (*par.* 17), 13179, 13248.
Length of zone required, 13069, 13238.
Experiments as to, advocated, 13182.
Object, particular, of zone watering, 13165.
Wattstown, breach of shot-firing rules at, 13175.
Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

STEVENSON, Mr. H., Agent and Manager of Linby Colliery, Nottingham. (*Leen Valley Coal Owners' Association.*) (*See questions* 15937A—16112.)
Accidents :
Number of, from falls of roof and sides, improbability of increase in event of watering, 15937A (*par.* 8), 15957.
Breach of Coal Mines Regulation Act constituted by such accidents, views of inspector as to, 15957.
Blackwell Colliery Explosion, course traversed by 15937A (*par.* 10).
Camerton Colliery Explosion, cause of (shot-firing), 15937A (*par.* 2), 16047, 16086.
Chesterfield and Derbyshire Institute, dust experiments and definition of an explosion, 16055.
Courrières Colliery Explosion :
Cause of, possibly dust, but not shot-firing, 15937A (*par.* 4).
Comparison with English collieries impossible owing to different character of coal, 15937A (*par.* 3).
Dust analysis, 15989.
Dust in Mines :
Character of Midland Collieries as to dust, 15990, 16017, 16076.
Classification of mines as dusty or non-dusty, difficulty of, 15937A, 15990.
Experiments, *see that title.*
Explosions :
Cause of, 15937A (*pars.* 2 and 13), 15962, 16055, 16086.
Amount of dust required to carry on an explosion, 16028.
Definition of, by Chesterfield and Derbyshire Institute, 16055.
Midland districts, number in, 15937A (*par.* 1), 15998.
Prevention, possibility of, in Midland District, 15937A (*par.* 12).
Inflammability of various kinds of dust : Analysis of samples from Linby Colliery, 15989.
Haulage roads, dust from, differing very slightly from other dusts, 16083.
Prevention or removal of :
Brushing from floor after damping, 15937A (*par.* 12), 16079, 16104.
Salt, sprinkling, injury to men and horses might result, 15961.
Screening-plant, dust from :
Amount of, small, and prevention unimportant in Linby Collieries, 15937A (*par.* 5), 16074, 16076.
Removal of screens, difficulty of, 15937A (*par.* 6).
Types of screen, method of handling in relation to, 15946.
Wagons, dust in, *see title* Wagons.
Watering, *see that title.*
Zones, dry dustless, afterdamp would not be prevented by, 15937A (*par.* 10).
Experiments as to dust explosions, suggestion as to, 15937A (*par.* 2).
Chemical and microscopical analysis of dust advocated, 15945.
Hall, Mr., experiments by, 15937A (*par.* 2), 15989, 16032.
Shot-firing, experiments suggested :
Diameter of hole and its effect upon stemming, 16010.
Vortex rings, 15943, 16010.
Zones, power of, to arrest explosion, experiments advocated, 15937A (*par.* 10).
Explosions :
Definition, 16055.
Dust, *see that title.*
Experience of Witness as to : none in Leen Valley Collieries, 15997.
Shot-firing, *see that title.*
(*See also titles of* Explosions, *as* Camerton, Wingate, &c.)
Explosives Order :
Caution as to use of permitted explosives in Order of December 20th, 1897, not contained in other Orders, 16002.
Extension of, to main haulage roads advocated, 15937A (*par.* 13), 15996, 16110.
Training of men in use of permitted explosives, 15982, 16072.

Digitized by Google

STEVENSON, Mr. H.—*cont.*

Fiery Mines: Classification of mines as fiery or non-fiery, impossibility of, 15937A (*par* 1).

Galloway, Professor, evidence of, reference to, 15944.

Germany, watering system, 15937A (*par.* 4).
Introduction into England inadvisable, 16093.
Meissner, Herr, paper on, 16094.

Henshaw, Mr., evidence of, reference to, 15989.

Qualifications of Witness, 15937A, 15938.

Royal Commission on Coal Dust, importance attached to blown-out shots in, 15937A (*par.* 2).

Safety Lamps:
Explosions, number of, in mines in which safety lamps are used, 16047.
Indications of gas afforded by, 16035.
Oils used, effect of, on, 15970, 15977, 16036.
Power advocated: not less than the Hepplewhite-Ashworth Gray, 15937A (*par.* 14), 15970.
Oils used:
Colza petroleum, advocated, 15937A (*par.* 14), 15970.
Detection of gas, effect of, on, 15970, 15977, 16036.
Types:
Description of, 15972.
Standard, advocated, 15971.
Use of, in mines worked by Witness, 16059.
Watering, compulsory, in mines where safety lamps are used, views as to, 15937A (*par.* 9).

Shot-firing:
Abolition not advocated, but firing under restriction desirable, 15937A (*par.* 12), 16045, 16049.
Acts, Orders, &c.:
Adequacy of, if strictly adhered to, 16052.
Strengthening, suggestions as to, 15937A (*par.* 13), 15963, 15996, 16110.
Between shifts: prohibition except between shifts in main haulage roads, views as to whether desirable, 16110.
Diameter of hole, experiments as to, advocated, 16010.
Explosions caused by:
Blown-out shots, 15937A (*par.* 13), 15962.
Prevention of Explosions, possibility of, 15937A (*par.* 12).
Unknown quantity or circumstances causing, 15937A (*par.* 2).
Vortex Rings, 15937A (*par.* 2), 15943, 16010, 16086.
Extent to which practised in Leen Valley Collieries, 15941, 16057, 16061.
Notice to and permission from manager advocated before shot is fired in main road, 15937A (*par.* 13), 15963.
Person firing shot:
Certificated official advocated, 15937A (*pars.* 13 and 14), 15963, 15966*, 16000, 16045, 16064.
Board of Examiners, 15967, 16067.
Practice as to, in Linby Collieries, 16064, 16069.
Instruction in duties, 16070.
Training men in use of permitted explosives, 15982, 16072.
Unstemmed shots, danger of, as compared with blown-out shots, 16002.
Vortex rings, 15937A (*par.* 2), 15943, 16010, 16086.

Spontaneous Combustion, danger of, would be increased by watering, 15937A (*par.* 12), 15959.

Timsbury Explosion:
Cause of (shot-firing), 15937A (*par.* 2), 16047, 16086.

Ventilation:
Amount of gas in Linby Colliery, 16033.
Regulations as to gas in Linby Colliery, 16034.
Withdrawal of men, amount of gas justifying, 16040.

STEVENSON, Mr. H.—*cont.*

Wagons:
Dust from, 16026.
Dust-tight, type of wagon, &c., views as to, 16027.
Watering of coal in, would be injurious in Linby Colliery, 15937A (*par.* 5).

Watering:
Compulsory, universal, objections to, 15937A (*par.* 8), 15952, 16092.
Exemptions would probably not be granted by inspectors, owing to responsibility, 15937A (*par.* 8).
Purchase of water would be necessary at Linby Colliery, 15937A (*par.* 10).
Safety lamps, compulsory watering of mines in which used, would probably result in withdrawal of lamps, 15937A (*par.* 9).
Shot-firing, practice of, would be increased by, 15937A (*par.* 9).
Dangers and difficulties of, 15937A (*par.* 7).
Effect on roof, sides and floor in Leen Valley mines, 15953, 16013, 16095.
Nature of roof and floor, method of working, &c., in relation to, 16011, 16014, 16016.
Health of men, effect on, 15937A (*par.* 11).
Spontaneous combustion, danger from, 15937A (*par.* 12), 15959.
Extent to which practised at Linby Colliery and in Leen Valley mines, 15937A (*par.* 9), 15991, 15993, 16104.
Sanitary reasons, watering for, 16106.
Zones, watered:
Afterdamp would not be prevented by, 15937A (*par.* 10).
Arching of brickwork, difficulty as to: extent of arching required, &c., 16097.
Dangers and difficulties of, effect on roof, &c., 16095.
Impracticable in Leen Valley Collieries, 15955.
Plastered walls would render proper examination of roof and sides impossible, 15956.

Wingate Explosion:
Cause of (shot-firing), 15962, 15999, 16002, 16007.
Dust on roads not traversed by explosion, analysis not given in Report, 16029.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

TATE, Mr. S., Agent for Walter Scott, Ltd., Trimdon Grange, East Hetton, and Scotswood Collieries, &c. (*North of England United Coal-Trade Association*). (*See questions* 17294A—17547.)

Armstrong, Mr., evidence of, reference to, 17348.

Garnes, Mr., evidence of, reference to, 17297, 17329, 17348, 17536.

Coal Mines Regulation Acts, adequacy of regulations if strictly adhered to, 17294A (*par.* 9).
(*See also title* Shot-firing, *sub-heading* Acts.)

Courrières Explosion: doors for shutting off afterdamp, suggestion that lives might have been saved by, 17294A (*par.* 14).

Doors for shutting off afterdamp, suggestions as to, 17294A (*par.* 14), 17353, 17466, 17545.

Dust in Mines:
Character of Durham mines as to, 17294A (*par.* 1), 17375, 17432, 17515.
Danger from, extent to which appreciated, 17370.
Definition of a dry and dusty mine, 17429.
Explosions, 17432, 17514.
Cause of, 17517, 17521.
Engine roads, occurrence on, not on horse roads, 17377.
Force preceding flame, 17489.
Shot-firing Rules, adequate observance of, especially as to watering, would obviate danger of, 17334.
Ventilation, high standard of, danger of explosion increased by, 17402.
Wingate explosion, *see that title.*
Inflammability of, explosions proving, 17432, 17515.

Digitized by Google

TATE, Mr. S.—*cont.*

Dust in Mines—*cont.*

Prevention or removal of:

Brushing away:

Danger possibly increased by, if shot-firing is going on in mines, 17294A (*pars.* 6 and 7), 17332, 17435.

Engine places, inconvenience of brushing away on, and possible increase of danger by, 17294A (*par.* 6).

Extent to which carried on in Trimdon Collieries, 17294A (*par.* 5), 17341, 17425.

Watering, combined with brushing away, advocated, 17332.

Compulsion as to freedom from dust, views as to whether desirable, 17438.

Discretion of manager as to method, advocated, 17439.

Screening-plant, dust from:

Brick erection for carrying pulleys and doors up to heapstead level, for prevention of dust from going down downcast shaft, 17380.

Dampness of downcast shaft prevents much dust from going down, 17383, 17424.

Zones (dry, dustless):

Arching, distance from face at which, possible, 17536.

Compulsion as to, views as to whether desirable, 17440.

Firmore Explosion, inflammable nature of dust proved by, 17432.

Experiments:

Dust, inflammability of, experiments as to, advocated, 17433.

Permitted explosives, testing, 17520.

Explosions:

Afterdamp:

Doors for shutting off, suggestions as to, 17294A (*par.* 14), 17353, 17466, 17545.

Loss of life caused chiefly by, 17294A (*par.* 15).

Experience of Witness as to:

Engine roads, explosions occurring on and not on horse roads, 17377.

Seaham Colliery explosion, 17354.

Shot-firing, strict observance of Special Rules, Witness knows of no explosion in cases of, 17294A (*par.* 3), 17335, 17339.

Wingate explosion, 17348.

Ventilation in relation to:

Danger of explosion may be increased by high ventilation, 17402.

Reversing air-current, views as to, 17522.

(*See also titles* Dust, Shot-firing *and* Wingate Explosion.)

Explosives, Permitted:

Accidents, reduction in number of, owing to increased experience, 17294A (*par.* 3).

Safety in use of, with proper care, 17294A (*pars.* 1, 2 and 3).

Fire in mine at bottom of downcast shaft, fan to reverse air-current in event of, views as to, 17530.

Germany, watering system, application in Durham undesirable, 17437.

Qualifications of Witness, 17295.

Rescue Apparatus, utility of, views as to, 17359.

Doors for shutting off afterdamp, use of apparatus in fixing, views as to, 17478.

Restoration of ventilation, 17360.

Training of men in use of, necessity for, 17483.

Stations where men are trained, 17485.

Wingate explosion, communication might have been established with men by, 17359.

Safety Lamps, explosions caused by breaking of, 17337, 17339.

Seaham Colliery Explosion:

Afterdamp, death of men from, hastened by efforts of rescuers, 17354.

Rescue apparatus, use of, for restoration of ventilation, 17360.

Shot-firing:

Abolition of, in main haulage roads, views as to whether desirable, 17374, 17443.

TATE, Mr. S.—*cont.*

Shot-firing—*cont.*

Accidents resulting from, are caused only by carelessness or neglect, 17294A (*par.* 3).

Absence of accidents in mine managed by Witness during past year, 17294A (*par.* 1).

Acts of Parliament, Orders, Rules, &c.:

Adequacy of, if strictly observed, 17294A (*par.* 9), 17296, 17401.

Cartridge, but not detonator, carried by colliers, General Rule as to, 17321.

Notices warning men of danger of non-compliance with, 17294A (*par.* 10).

Blown-out shots, 17518.

Explosions, cause of, 17339, 17518, 17521.

Gas, amount of, with which shot can be fired in safety, 17294A (*par.* 8).

Notice to manager and permission from him before shot is fired in main haulage roads, practice as to, Trimdon Collieries, 17294A (*par.* 9).

Number of shots fired simultaneously and interval between shots, views as to, 17497.

Number of shots fired in mines managed by Witness and absence of any accident from use of explosives during past year, 17294A (*par.* 1).

Person firing shots:

Appointment of, practice as to, in Trimdon Collieries, 17294A (*par.* 9), 17298.

Book giving number of shots and district in which fired, signed by shot-firer, 17294A (*par.* 10), 17415.

General Rules as to, views as to whether desirable, 17418.

Instruction as to duties: rules printed on back of Authorisation (Trimdon Collieries), 17343.

Miner firing his own shot with powder, in cases where candles are used, 17446.

Safety lamps, mines in which used, and mines where high explosives are used, officials only should be allowed to fire shots in, 17294A (*par.* 11), 17446, 17452, 17464.

Single individual not to carry both explosive and means of firing it, suggestions as to, and practice as to, 17299, 17456.

General Rule as to, views as to whether desirable, 17314, 17321.

Roadways, main haulage, danger arises chiefly in, 17294A (*par.* 4).

Watering in neighbourhood of a shot, adequacy of rules as to, if properly carried out, 17294A (*par.* 8), 17334, 17339.

Witness knows of no instance of an explosion where watering rules have been properly observed 17294A (*par.* 9) 17366.

Timbering, injurious effects of watering on, 17294A (*par.* 4).

Ventilation:

Danger of explosion may be increased by high ventilation, 17402.

Reversing air-current, views as to, 17522.

Wagons, dust from, 17378.

Watering:

Arrest of explosion by, 17294A (*par.* 12).

Compulsory universal watering undesirable, 17437 17540.

Danger and difficulties of:

Effect on roof, sides and floor, 17294A (*par* 4), 17326, 17394, 17437, 17540.

Health of miners, effect on, 17534.

Extent of, 17395.

Thorough watering impossible in many mines, 17326.

Frequency with which necessary, 17294A (*par.* 4), 17329.

Sanitary purposes, watering for, 17342, 17408.

Temperature of mine, effect of, on, 17533.

Timbering, injurious effect on, 17294A (*par.* 4).

Zones, watered:

Arrest of explosion by, probability of, views as to, 17294A (*par.* 12), 17347, 17387, 17401, 17410.

Arching, 17294A (*par.* 13).

Compulsory provision, views as to, 17440.

Length of zone advocated, 17294A (*par.* 12) 17410.

Position of, 17294A (*par.* 12).

Digitized by Google

TATE, Mr. S.—*cont.*

Wingate Explosion :
Afterdamp :
Deaths from, 17358, 17390.
Reversing of air-current would not have taken afterdamp out, 17523.
Arrest of, by damp area, 17389.
Cause of—shot-firing, 17318, 17519.
Course traversed (apparently dustless zone), view of Witness that dust was present in this zone, 17348.
Dust, inflammable nature of, proved by, 17432.
Rescue apparatus, communication with miners might have been established by means of, 17358.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

TODD, Mr. JOHN T., General Manager of the Blackwell Colliery Company, Ltd. (*Midland Counties Colliery Owners' Association*). (*See questions* 13662A—14182.)

Blackwell Colliery Explosion, arrest of, by dustless zone, theory disagreeing with this assertion, 13734.

Blaendare Explosion, cause of, 14115.

Chesterfield Mining Institute, experiment with dust, 13669.
Districts from which dust was drawn, 13844.
Report, extract from, 13674.

Cornish Mines, watering, timber apparently not affected by, 14151.

Drumpeller Explosion, cause of, 14113.

Dust :
Character of mines as to, 13887, 14040, 14141.
Classification of mines as dusty and non-dusty, difficulty of, 13662A (*par.* 1), 13669.
Explosions, cause of, 13662A (*par.* 3), 13669, 13763, 13849, 13892, 14005.
Amount of dust required to cause an explosion, 14035.
Face :
Amount of dust at, small, 13866.
Harmless character of, in long-wall workings, 13662A (*par.* 5), 14037, 14088, 14091.
Difference between fiery and non-fiery mines in this respect, 14089.
Inflammability of various kinds of coal dust, 13662A (*par.* 1), 13669.
Fine dust on main haulage roads most inflammable, 13662A (*pars.* 2 and 4), 13678, 13705.
Non-explosive inflammable dust, 13673.
Carrying-on of flame by, if started, question as to, 13682, 13690.
Prevention or removal of, views as to :
Brushing away, 13704, 13739.
Mixing of non-inflammable matter with coal dust, 13676.
Screening-plant, dust from, 13662A (*par.* 7).
Zones, dry dustless, suggestions as to, 13662A (*par.* 16).
Absolute freedom from dust, impossibility of securing, 13662A (*pars.* 8 and 10), 13739, 13860, 13897, 13949.
Advantage of dry dustless zones, views as to, 14030.
After-damp, poisonous gas, &c., would probably not be arrested by, 13992.
Arching, 13662 (*par.* 8), 13728, 13897.
Deep mines, difficulty of arching in, question as to, 13899.
Arrest of explosion by, views as to possibility of, 13731, 13740, 13855, 14030.
Experiments as to, required, 14136.
Failure to arrest, Elemore explosion an instance of, 13732, 13737A, 14128.
Discretion of manager as to dry or watered zones advocated, 13947.
Disputes as to, method of settlement suggested, 14017.
Frequency with which brushing away would have to be repeated, 13662A (*par.* 10), 13739.

TODD, Mr. J. T.—*cont.*

Dust—*cont.*
Prevention or removal of, views as to—*cont.*
Zones, dry dustless, &c.—*cont.*
Length required, 13662A (*par.* 16), 13731, 13737A.
Number of : one for each ventilation road advocated, 13944.
Object, chief, of, 13992.
Position of zones :
Between face and main haulage roads, views as to, 13868, 13891, 14013.
Face, nearness to, 14002.
Main haulage roads, views as to, 14004.
Ventilation roads, 13944.
Roadways : Main haulage roads, amount and inflammable character of dust in, 13662A (*par.* 4), 13703, 14088, 14110, 14121, 14141.
Screening-plant, dust from, 13662A (*par.* 6).

Elemore Explosion :
Arched zone failing to arrest, 13732, 13737A, 14128.
Evidence as to, given before Royal Commission on Coal Dust, 14129.
Cause of, 14029.
Experience of Witness as to, 14024.
Face, explosion penetrating to, 14095.

Experiments as to dust :
Advisability of, suggestion as to, 13662A (*pars* 12, 13 and 16), 13762.
Shot-firing, 13973, 14079.
Zones, dustless, 13903, 13738, 13861, 14136.
Chesterfield Mining Institute, experiments made by, 13669, 13844.

Explosions :
Causes, other than shot-firing, 14112.
Death-rate from, comparatively small, 13662A (*par.* 13).
Dust, *see that title.*
Elemore Explosion, *see that title.*
Experience of Witness as to, 14024.

Explosives :
Gunpowder :
Dangerous character of, 13893, 14065, 14071.
Explosion caused by, 14113.
Permitted explosives, use of, 13662A (*pars.* 13, 14 and 15).
Bellite and Ammonite, 14068.
Carbonite, 13662A, 13765, 13772, 14068, 14069.
Classification advocated, and use of only the highest class of explosives on main haulage roads, 13662A (*par.* 14), 13775, 13801, 14068.

Explosives Order, satisfactory working of, 13662A (*par.* 13).

Fowler, Mr., evidence of, reference to, 13722, 14032.

Germany, Watering System :
Application to England undesirable, 13662A (*par.* 17), 13787.
Cost of watering on similar system in England, question as to, 13932.
Timbering apparently not injured in Westphalian mines, 14149.

Lancashire, Special Rule as to shot-firing, conversion into General Rule advocated, 13972.

Maclaren Explosion, cause of, 14117.

Merthyr Explosion, cause of, 14114.

Method of Working mines, 13662A (*par.* 7).

Plan showing the actual working in a mine, 13862.

Qualifications of Witness, 13662A, 13663, 14022, 14051.

Royal Commission on Coal Dust, evidence as to Elemore explosion, 14128.

Seaham Colliery Explosion :
Cause of, 14103.
Course traversed—whole of main haulage roads, 14105.

Digitized by Google

TODD, Mr. J. T.—*cont.*

Shot-Firing:
Abolition of, on main haulage roads, views as to whether desirable, and as to extent to which number of explosions would be reduced by, 14111, 14123.
Absence of men from mine during, advisability of, 13662A (*par.* 14), 13785.
Acts, Orders, Regulations, &c.:
Strengthening of, as regards main haulage roads advocated, 13662A (*par.* 16), 13775, 13807, 13955.
Strict observance of, importance of, 13662A (*par.* 14), 13763, 13773, 14112.
Blown-out shots, 13662A (*par.* 14), 13674, 13686, 13892, 14065, 14069, 14070, 14080, 14083.
Classification of permitted explosives advocated, and use only of highest class for shot-firing in main haulage roads, 13662A (*par.* 14), 13775, 13801, 13955.
Decrease in practice of shot-firing on main haulage roads, 14124.
Explosions in relation to, 13662A (*par.* 13), 13674, 13686, 13892, 14065.
Fiery mines, prohibition of shot-firing in, unnecessary if permitted explosives are used, 13968.
Notice to and permission from manager, Lancashire Special Rule as to, conversion into General Rule advocated, 13972.
Number of shots fired in colliery managed by Witness, 13662A, 13764, 13957.
Object of and necessity for, in main haulage roads, 13965.
Official, special, appointment by manager for shot-firing in main haulage road advocated: charge to be inserted and stemmed by him, 13662A (*par.* 14), 13780, 13803, 13958, 14055, 14064.
Ripping shots, definition, 13769.
Roadways, main haulage roads, shot-firing only under special circumstances, 13760, 13766.
Watering in neighbourhood of a shot, strict observance of rule as to, advocated, 13662A (*par.* 14), 13781.
Zone, watered, shots fired at distance of half a mile from, 13754, 13756.

Small Coal put into gob, 14173.

Spontaneous Combustion, mines subject to, danger of extensive watering in, 13662A (*par.* 17), 13792, 14172.

Timber, effect of watering on, 13715, 13836, 14046, 14147, 14158.
Cost of timbering in wet and dry mines compared, 14048.
Extent of timbering, 13841.
Steel girders, 13718.

Ventilation: Absence of gas in Midland District, 14038.

Wagons:
Dust from, 13662A (*pars.* 6 and 7), 13694, 14142.
Dust-tight, views as to, 13694, 14137, 14153, 14178.
Loading, method of, 13662A (*par.* 7), 13694, 13696, 14137.
Type of, 13662A (*par.* 7), 13694, 14137, 14153.
Watering as they go along:
Injury to screens would probably result, 14145.
Not practised in Midland district, 13700.

TODD, Mr. J. T.—*cont.*

Water, Natural, in mines: proportion of moisture in coal in different districts, 14146.

Watering:
Amount of water that would be required for thorough watering, 13937.
Arching:
Importance of, 13726.
Impracticable in many Derbyshire and Nottinghamshire mines, 13728.
Compulsory universal watering impracticable, exemptions would have to be numerous, 13662A (*par.* 8), 13727, 13858.
Cost of, estimate of, 13932, 13942, 14161, 14170.
Dangers and difficulties of:
Effect on roof and sides, 13709, 13725, 13832, 14045, 14053.
Timber, effect on, 13715, 13836, 14046, 14147, 14158.
Extent of, and extent desirable, 13662A (*par.* 8), 13707, 13742, 13790.
Sanitary purposes, watering for, 13662A (*par.* 8), 13742, 13790.
Spontaneous combustion, mines subject to, danger of watering in, 13662A (*par.* 17), 13792, 14172.
Steel girders and props, use of, instead of timber, question as to, 13718.
Strata, nature of, in relation to, 13815, 14161.
Tank and spray system, 13662A (*par.* 9), 13788, 13910.
Amount of water required, 13662A (*par.* 10), 13933, 13976.
Arrest of explosion by, views as to whether probable, 13911, 13915, 13917, 14041.
Cost of as compared with hose and standpipe system, 13987, 14170.
Plate illustrating, 13913.
Time of watering—before beginning of shift, 13983.
Zones, watered, views as to, 13662A (*par.* 16).
Advantages of dry as compared with wet areas, 13729, 13743, 13909.
After-damp would probably not be arrested by, 13992.
Amount of water required, 13932, 13975.
Arching, 13726, 13729.
Compulsion or General Rule as to, inadvisable, 13662A (*par.* 8).
Cost, estimate of, 14018, 14170.
Discretion of manager as to length and position of zone advocated, 13746.
Frequency of watering, views as to, 13982.
Impracticable in some mines, 13744.
Length of zone, views as to, 13662A (*par.* 16), 13746, 13747.
Number of zones—one in each ventilating road advocated, 13748.
Object of, views as to, 13758, 13794, 13796.
Position of zones:
In ventilating road, 13748.
Distance from face, 13795.

Zones, *see title* Dust, *sub-heading* Prevention, *and title* Watering, *sub-heading* Zones.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

This book should be returned to the Library on or before the last date stamped below.

A fine of five cents a day is incurred by retaining it beyond the specified time.

Please return promptly.

6711172

BOOK DUE-WID

MAR 12 1980

MAR 17 1980

BOOK DUE WID

CANCELLED

JUL 9 1980

SEP 28 1981

Digitized by Google

3 2044 079 966 842

Digitized by Google